AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 12, No. 23. WEEKLY. | NEW YORK, THURSDAY, JUNE 6, 1889. | $2.50 per Annum. SINGLE COPIES 5 CENTS

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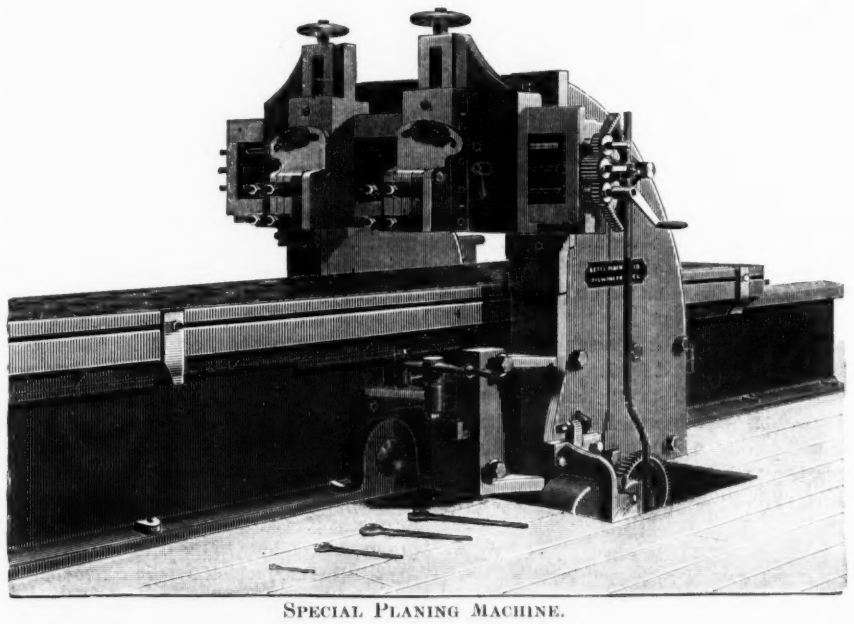
A New Special Planing Machine.

The cut shown herewith is that of a special machine built by Betts Machine Co., Wilmington, Del., for planing wrought-iron and steel, when heavy duty is desired. The machine is made in two styles and two sizes. The style shown is that known as the "low upright" machine, and will take in work 42 inches wide by 12 inches high; a similar one is made to take work 36 inches wide by 12 inches high. The other style is known as the "high upright" machine, of which two sizes are built—one of which takes work 36″ square, and the other 42″ wide by 36″ high. The design of these machines exhibits some novel features, a few of which are noted here. The first impression is that of massiveness, which is well borne out by the absence of all ornamentation, and by large plane surfaces. The construction of the machine is simple, and such as to secure accessibility for repairs. All fast running parts are bushed with brass, and the whole is intended to withstand rough usage and heavy duty. The bed rests directly on the foundation, is deep, and of heavy section, strengthened in the center and not cut to allow gearing to clear; its length in regard to the table is ample. The ways of the bed are somewhat of a departure, being flat on the top and sides, instead of the usual V-shape; and the table is *gibbed* down; this, together with the flat ways, making it impossible to raise the table—the flat ways are adopted with the belief that the best way to take the thrust of the tool is on a flat surface. The gearing and pulleys are ample for an ordinary 7 feet wide planer, and have at a convenient point a "breaking pin," which shears off before the gears can be broken—this pin can be replaced in a few minutes, and at a trifling cost, and allows a machine to be pushed to its utmost without danger of damage. The driving shafts are of steel and of large diameter, the length between gears and pulleys being very short, to reduce torsion to the minimum. The pulleys are proportioned to return the table at five times the cutting speed. The stops or dogs for reversing the motion do not project beyond the edge of the table, and are thus prevented from catching or striking the operator. The table can be easily reversed at any time by a single motion of a convenient lever, or it may be entirely stopped without stopping the countershaft. The belts are transferred one at a time, and are locked at all times. The uprights are of box form, with a very wide face; they extend down the entire depth of the bed, and are securely keyed and bolted thereto. The cross-rail is very heavy, and carries two saddles, which are made right and left, in order to bring the tools close together, the apron holders being made the same way. The saddles and tool slides are provided with hand-feeds and with automatic feeds, independently reversible, or which can be thrown out of gear entirely at any time. All wearing parts have means of compensation for wear, and the machine is intended to withstand rough handling and hard work.



SPECIAL PLANING MACHINE.

Philanthropic Manufacturers.

Of course we all know that our manufacturers as a class are a first-rate set of men, and none will deny that they possess virtues which entitle them to the respect of their fellow-men. But every one, including even the manufacturers aforesaid, will, we think, be surprised to learn that most of our manufacturing enterprises have been started, not from selfish motives at all, or from the mere desire for the possession of filthy lucre, but from motives of the purest unselfishness and most exalted philanthropy and patriotism. At a banquet recently held in this city, Gen. Daniel Butterfield said in an after-dinner speech: "The greatest number of the manufacturing industries of the North have been made in their early days, not for the accumulation of wealth, nor for the aggregation, so to speak, of money at the expense of the labor of the few, but in the honest efforts of individuals to benefit their locality by finding occupation for those who were unemployed, by keeping the people at home to increase the happiness of their families and to benefit their country, their immediate locality, and to do that which in their judgment they considered best for all."

But after all, we suppose that considerable allowance should be made in view of the fact that that was an after-dinner speech. At any rate, we think we know of several manufacturing enterprises which, to judge from the appearances, were started for the every-day, common, prosaic purpose of making money, and we do not believe it is practicable to carry on manufacturing on any other basis than that.

Soft Coal in New York.

The citizens of New York will, we think, soon awaken to the fact that they have a genuine grievance against the anthracite coal monopoly. Scarcely any one who has occasion to cross the North or East Rivers very often can fail to notice the increasing use of soft coal, both in the manufactories of the city and by the steam-driven craft in the rivers and harbor. Many of the tug-boats, which eighteen months ago were burning anthracite coal, are now using soft coal, and leaving behind them a trail of inky smoke, which spreads over the water, and remains plainly perceptible for hours. Some of the ferryboats, even, are using it, while Babbitt's soap factory pours out vast volumes of smoke, which, at times, obscure the entire lower part of the city from the North River. Until recently one of the attractive features of New York city has been the clearness of its atmosphere; but if the use of soft coal goes on increasing as it has done in the past year, the view of the city from a distance will soon resemble that of Pittsburgh before the introduction of natural gas, and the famous beauty of New York Bay will be a thing of the past—existing only in tradition.

Not only this—but the proportion of time in which the navigation of the rivers and harbor is dangerous, by reason of the thick atmosphere, is bound to be much increased by this smoke, if, indeed, it has not been already. We think the matter is one of serious import, and that incalculable injury is likely to result to the city from it, unless its use can in some way be checked. We can think of no way of checking it, however, so long as the anthracite combination retains the power of dictating to the American people just what amount of hard coal they shall burn, and shutting up the mines whenever they choose, in order to increase prices or starve the miners into an humble and submissive condition. An equally strong combination of the soft coal mine owners might make the price of soft coal high enough to induce a return to anthracite, but of that there is not much prospect; and the day seems not far off when no one will see Liberty statue without going to the island upon which it stands.

The Johnstown Disaster.

Nothing more terrible has ever happened in times of peace in this country, than the destruction of life at Johnstown. At this writing, nothing like a correct estimate of the loss of life can be made, but the number appears to reach the thousands. There are a good many things to be thought of in connection with this disaster; one is, should the construction of a dam be permitted, where its giving away would cause such loss of life? Stories are conflicting as to opinions of the safety of this dam, but it is not to be presumed that those who maintained it for purposes of pleasure did so without what would be considered competent engineering advice as to its ability to withstand the enormous pressure to which it was subjected. If this is true, then it is plain that engineering science was at fault, and is a strong argument against permitting the setting of such traps. Another thing likely to result from this disaster is a careful examination and a strengthening of existing dams. There may be more such traps as that at Johnstown.

It is always satisfactory to hear of coming sense. A year or two since a company—on paper—was going to put down pneumatic tubes for transporting merchandise all over the country, and they proposed a speed equal to the initial velocity of a cannon ball. Now there is another scheme for transporting parcels, in which electricity is to play a part, but it is noticeable that no higher speed than about two hundred miles per hour is claimed. As an evidence of coming sense, the reduction in speed is very satisfactory.

Hoisting Rig.

BY ROBERT E. MASTERS.

Figs. 1 and 2 (page 2) are plan and side elevation of a cross used for lifting heavy moulds. The upper part of this cross is level, and the under part tapers, as shown by the lines *A. B.* Instead of having recesses or notches in below the line of the beam for the stirrups to rest in, it has square projections *C, C* cast on the beam. The staple *D* is of 1¼″ iron; all the other sizes of the cross are given on the drawing.

Figs. 3 and 4 are plan and section views of an arm to lengthen the cross. There are, of course, four of these, having a pocket at *E* to fit over the end of the arm, as shown in section at *F*. There are stirrups, Fig. 5, of various lengths (four of each length to a set), made of square iron. The extension hooks, Fig. 6, are also of square iron, and the eye *G* is made to fit over the beam and between the projections *C*.

It often happens that neither of the lengths of stirrups will suit to suspend the mould in the cross when ready to move it or bind it together, the stirrups being either too long or too short; by hanging the hooks, Fig. 6, on the end of the beams, and suspending the stirrup, Fig. 5, in the hooks, the right length is often obtained. This rigging has been satisfactorily used for a long time on heavy loam work in a foundry with which the writer was once connected.

If a new rigging was to be gotten up, I would prefer a cross made as shown by dotted lines *H* and *I*. The straight line *I* underneath is better to wedge against when using a cross to bind the mould together; and an eye bolt, made of round iron, suitable to the size of the cross, and extending about 8″ above it, is preferable to the staple *D*. The stirrups can be made of round iron, one end like Fig. 7, to fit over the end of the cross into the notches *J*; the other end of the stirrup is on the same plan, only the eye must be large enough to fit over the lugs on the base or bottom plates. The turn buckle, Fig. 8, in the center of a set of stirrups of this style, will make them answer for several lengths.

One great difficulty in handling long, top-

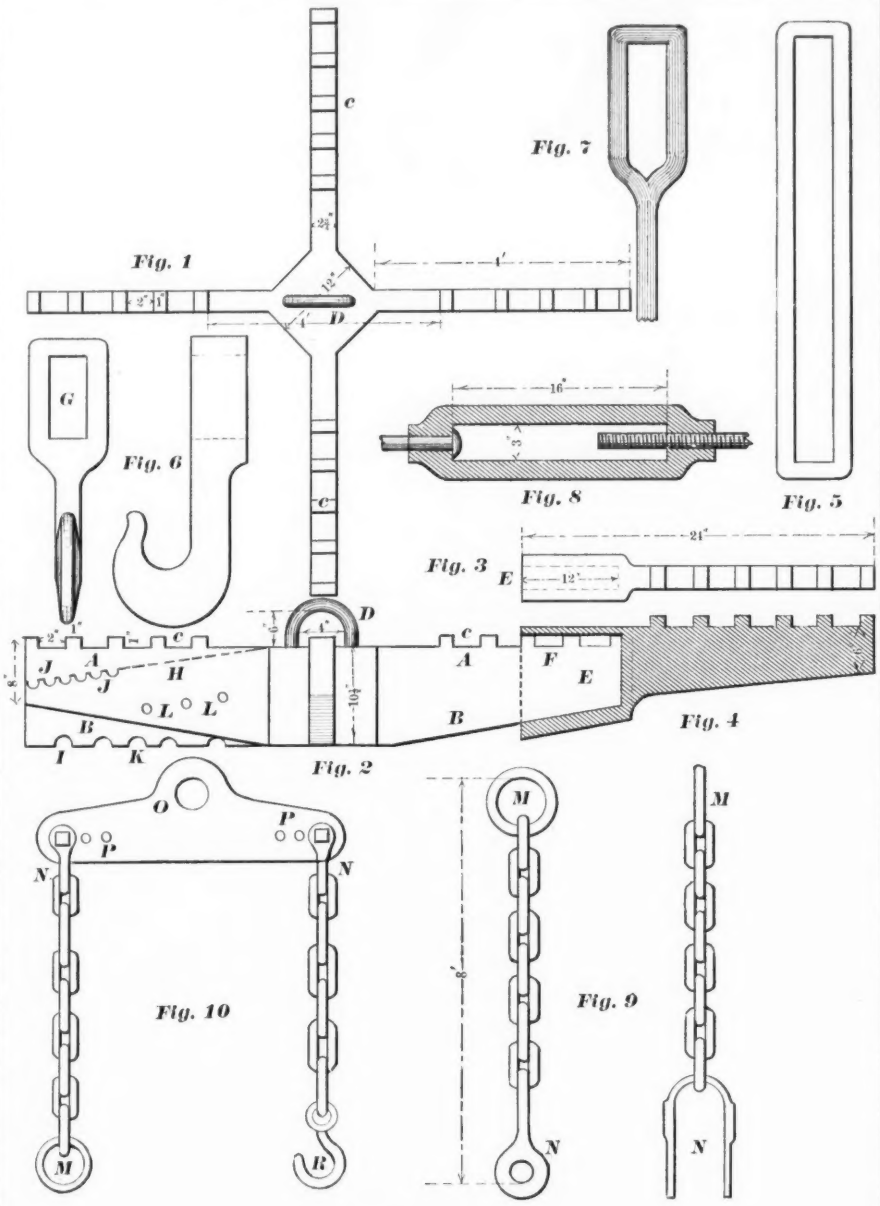
heavy moulds is their liability to turn over. I well remember in 1884 I had a lot of drums or cylinders to make in loam, the cores of which were 3 feet diameter and 12 feet long. It required the utmost care to keep this core balanced while lifting it on the carriage to put it in the oven, or to lift it into the pit. We were using the last described cross and stirrups. At that time an article appeared in the AMERICAN MACHINIST from the pen of Thomas D. West, on "Balancing Heavy Moulds," showing a set of four short chains fastened in one large ring to fit over the crane hook. Then there were four hooks, with a large link attached to each. The links were put over the arms of the cross into whichever of the notches *K* was most suitable for balancing the mould. The hooks were fastened in the end of the chains on the large ring, and the cross and mould lifted with this arrangement.

The cross we were using had no notches *K* in the under side, so I had holes drilled at *L* to correspond, and had four chains of the required length fastened into one large ring, with a cuff on the end of each chain similar to the cuff *N*, *N*, Fig. 9. The crane hook was fastened in the large ring (instead of the eye bolt in the cross), the cuffs put astride the arms of the cross, and a bolt put through the cuff, and the most desirable hole at *L*. The mould could then be lifted and moved without any difficulty or danger. Each of the four chains, from the large ring to the bolt hole in the cuff, was 32″ long.

Figs. 9 and 10 are beam and chains used in a large pipe foundry. These chains are from 4 to 8 feet long. The cuff end is made to fit, and is bolted through the beam *O*. The holes *P* allow the chains to be moved closer together, so as to fit several sized casings. The rings or hooks *M* and *R* (whichever is preferred) are put over the trunnions on the casings to lift them by. I have seen cast-iron pipe flasks, 13 feet long, lifted by this rigging in and out the pits, and twisted and turned in every direction, while they were handled very rapidly by power cranes, where a rigid pair of stirrups, instead of the chains, would not answer at all.

How often we see moulders working under large green sand copes that are swung in the crane from a straight beam and chains, or chains alone. A number of men have been injured in this way from chains, beam, or something giving way, when a few moments taken to put trestles or a few flasks and wedges under the edges of the cope would keep it from swinging while being dressed; and if anything about the crane should give way, there is not much danger of the moulder getting hurt. No reasonable foundry foreman would object to the time taken to make the work safe, when perhaps just to save these few moments a man may be laid up for months; the trouble is, the moulders voluntarily take these risks.

Yesterday I received a letter from a moulder in Missouri, who formerly worked for me. On this point he says: "Last week the crane-chain broke, and the mould fell on my legs; the doctor cannot tell whether there are any bones broken in my feet or not—they are so badly swollen, don't know when I will be able to be around again."



HOISTING RIGS

(SEE PAGE 1.)

vention; and yet it does not appear that they have been able to discover any way in which they could improve the principal tool they use, and the one upon which their eyes constantly rest.

There have been, it is very true, great improvements suggested by those outside of the trade in making the anvil element enter into combination with others, for the purpose of comprehending a greater or less number of workshop tools in one system. Among these forms, perhaps as great a favorite as any with the daring trespassers upon the smith's province is the vise united with the anvil. Vise, tire-shrinker, and anvil, is another. Vise, anvil, and drill press, is the fond fancy of some economist. A tool dressers' anvil with impressions in the face for shaping side tools, and cutting off diamond points, with also a hand shear attachment for clipping the corners of drills is a very good device for that particular branch of the business; but the demand for such a combination is more fanciful than real, as all the dies for these purposes, if any are used, can be made to fit in the square hole in the common anvil, and the small shear, which is very convenient for the drill dresser, can be attached to the forge or the tool bench with rather greater advantage.

The combined anvil and dolly is the combination which is most in use, and this use is principally confined to the chain makers, among many of whom it is considered indispensable. I do not know that they are placed on the market for sale anywhere in this country. The anvil part is made of cast-iron, and every chain maker who has any peculiar ideas of own, which he desires to put into practice, can easily have a pattern made to accord with them, modifying in some detail the general style shown in Fig. 1, which represents an anvil 10 inches long, and 3¼ inches broad on the face, 8 inches high, and with a strong, blunt horn.

Fig. 2 shows the bottom die, the face of which, containing the forming groove, is of steel, the rest being of wrought-iron. The shank is to be inserted in the hole shown in the side of the anvil, and is fastened by two keys on top, tapering in opposite directions. A wedge of very little taper is driven between it and the ledge shown in the figure below the hole. This makes a solid bearing, which is a very important matter to the man who is using his muscle with the hammer. It is better than the plan of letting the ledge come up flush with the bottom of the hole. The shank can be securely fastened in the hole, and firmly wedged down against the bottom of it, before the ledge wedge is put in. There is no strain liable to break the shank off at the neck, caused by driving the ledge wedge, and whatever wear is suffered from the constant striking upon the dolly and reaction through the die is taken up in driving the wedge without being noticed, while if the die rested directly upon the ledge at first, it would get slight service before it would so wear as to no longer have a solid bearing. It would then be necessary to use packing under it, and this cannot be adjusted as easily as a wedge can be driven.

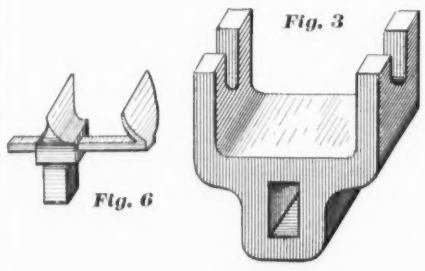
Fig. 3 shows the boxing for the dolly, and has in the lower part of the frame a hole, so that it can be put on the part of the die shank which extends through the anvil for the purpose of affording it a support. The head of the dolly sometimes has a bit of steel welded on it, and the face is generally made of steel; the rest of it is of wrought-iron.

The whole arrangement is shown put together in Fig. 5, with the simple but efficient device of a bent wire and a weight to hold the bearings in the boxing. Sufficient weight is hung on to make it bind hard enough to hold the dolly up when not in use. When the smith has given it the two or three blows necessary to smooth off the weld in the chain link or ring which he is working on, he gives the dolly an oblique upward blow, which raises it up off from the die, and leaves an open space large enough to put the work into the rounding groove without any hesitation when the welding heat is on it.

With this very convenient tool, excellent chain is finished up in a neat and workmanlike manner, of any size up to half an inch in diameter.

Fig. 6 represents a "gauge-hardy," which is sometimes used in the hole in the face of the anvil, when the work does not come to the forge already cut to the right length. The gauge rod is keyed in a hole in the hardy, in preference to being fastened with a set-screw, as set-screws easily jar loose, and quite frequently break off.

A very good tuyere iron for a chain makers' fire is a cast-iron box 8″x4″x2″ inside measurement. The blast pipe enters a 2″ hole at one end, and in one of the narrow sides are drilled holes ¼″ in diameter and about 1½″ apart. The box should be ⅛″ or ¼″ thick on the side where the blast holes are drilled. This tuyere forms the front of the fire, and the blast blows the fire away from the workman. The inside of the box is cored out, and the blast holes are drilled of any size and distance apart that is found to be best adapted to the kind of work. The boxes are sometimes made with only five sides, being left open on the lower side, and bedded in mortar or clay when they are set. This saves making a dry sand core, and gives a little better chance to clean out the blast holes if they get stopped. The cored box can be cleaned, however, from the pipe hole, and is not subject to the objection of leaking air when the setting gets loose.

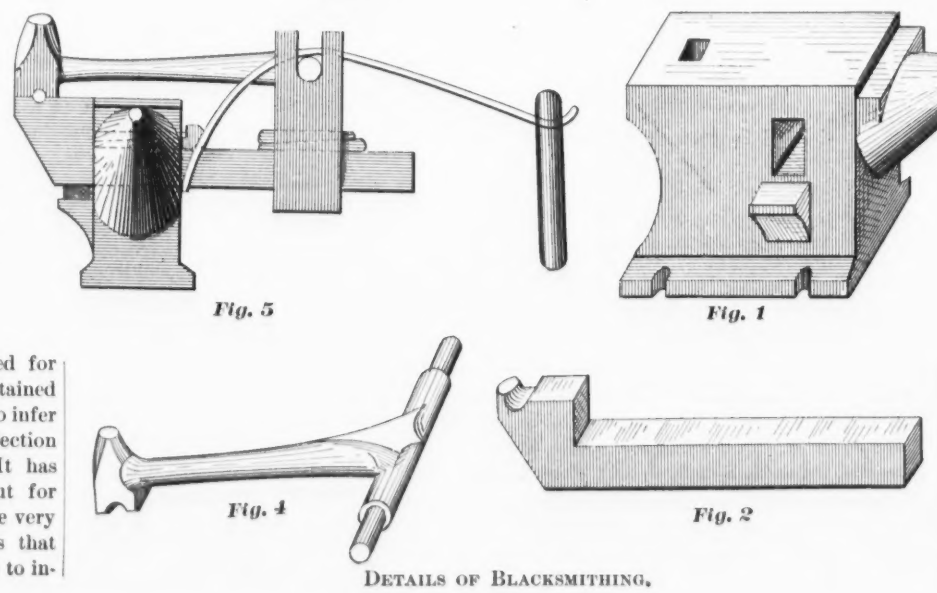


Practical Details of Blacksmithing.

BY B. F. SPALDING.

THE COMMON ANVIL—ATTEMPTED IMPROVEMENTS BY COMBINATIONS—TOOL DRESSERS' ANVIL—CHAIN MAKERS' ANVIL—TUYERE IRON FOR SMALL WORK.

Judging from the length of time during which the common anvil, used for general purposes by blacksmiths, has retained its present form, it may be reasonable to infer that it has attained very nearly to perfection in its shape, if not in its material. It has been hammered upon day in day out for many years by very ingenious men, the very nature of whose occupation demands that they be fertile in resources, and prone to in-



DETAILS OF BLACKSMITHING.

Practical Drawing.

BY J. G. A. MEYER.

SEVENTY-EIGHTH PAPER.

568. It will be well to draw attention to the manner in which we have represented the planes of projection in Figs. 475 and 478. In geometry, whenever it is necessary to show the planes of projection, they are simply represented by straight lines, and not by the edges of drawing-boards, as we have done. Again, in Figs. 476 and 477 we have represented the planes of projection by rectangles, but it must be remembered that a plane of projection is not limited in size, and therefore, in geometry, and also in working drawings, the boundary lines of these planes are never shown. (See Art. 248.) The reason for adopting this method of showing the planes of projection was simply to make the subject as plain as possible for beginners and practical men. Lastly, sometimes in working out the solution of a given problem it will be necessary to show the ground line $A\ B$ (Fig. 477), but in working drawings this line is also omitted.

569. A projection or drawing of a pyramid is a very simple thing, yet our experience in teaching drawing has convinced us that those not familiar with drawing may have difficulty to interpret correctly a drawing of a pyramid and objects of similar character; hence a few remarks as to how to read a drawing of this kind may be advantageous to beginners. Therefore let us consider how the plan $G_2\ H_2\ I_2\ K_2$, in Fig. 473 (last paper), should be interpreted. Persons unfamiliar with geometrical drawing may assume that the diagonals $G_2\ K_2$ and $I_2\ H_2$ are simply drawn for the purpose of calling attention to a surface, and that these diagonals do not represent anything in particular; indeed, there is an excuse for such mistaken ideas, because we often meet with drawings in which such conventional methods are adopted; for instance, in deck plans of ships we often see diagonals drawn across the berths for no other purpose than to draw attention to these berths. In geometry such conventional methods are not used; the lines in geometrical drawing are either construction or auxiliary lines, showing the location of things in reference to others, or they represent some parts of the object shown. Here, then, the question arises, what do the diagonals $G_2\ K_2$ and $I_2\ H_2$, in Fig. 473, represent? These diagonals represent the lateral edges of the pyramid; or, we should say, they are the horizontal projections of the lateral edges of the pyramid; thus $V_2\ G_2$, one-half of the diagonal $G_2\ K_2$, represents that edge which in the elevation is represented by the line $V\ G$. Again, $V_2\ H_2$, one-half the diagonal $I_2\ H_2$, represents that edge of the pyramid which is represented in the elevation by the line $V\ H$; and lastly, $V_2\ I_2$ and $V_2\ K_2$ represent those edges of the pyramid whose vertical projection coincide with the lines $V\ G$ and $V\ H$ in the elevation. The point V_2 is the horizontal, and the point V the vertical projection of the vertex of the pyramid. In the plan the triangles $V_2\ G_2\ H_2$, $V_2\ H_2\ K_2$, $V_2\ K_2\ I_2$ and $V_2\ I_2\ G_2$ are the horizontal projections of the lateral faces of the pyramid; and the lines $G_2\ H_2$, $H_2\ K_2$, $K_2\ I_2$ and $I_2\ G_2$ are the projections of the edges in which the lateral faces and the base meet. A shaded drawing of a pyramid, as Fig. 480 or Fig. 479, will give us a clearer conception of the meaning of the diagonals drawn in the plan of the pyramid. But it must not be understood that in every drawing of a right pyramid the vertex will lie in the center of its projection, and its edges will be represented by diagonals. We may sometimes be compelled to show a pyramid in an oblique position; under these conditions its projections will appear as shown in Figs. 481 and 481*a*. The manner of finding a horizontal projection of this kind we shall explain presently.

570. Fig. 479 represents a horizontal projection of a right pyramid with a hexagonal base—here, of course, each half of any one of the diagonals $a_2\ d_2$, $b_2\ e_2$, etc., represents, as before, a lateral edge of the pyramid. It will be well to draw the attention to the fact that in the vertical projection, Fig. 479*a*, the line $v\ a$ shows the true length of the lateral edge of the pyramid, because the horizontal projection $a_2\ v_2$ of the same edge is parallel to the vertical plane of projection; for a similar reason the $v\ d$ also shows the correct length of the lateral edges of the pyramid. The lines $v\ b$, $v\ c$ do not show the correct length of the lateral edges of the pyramid, because the horizontal projections of these edges are not parallel to the vertical plane of projection. Here the question may arise, how do we know that the diagonal $a_2\ d_2$ (Fig. 479) is parallel to the vertical plane of projection? In referring to Art. 220 we find that the ground line is always a horizontal line, and since the diagonal $a_2\ d_2$ is drawn in a horizontal position, we know that it must be

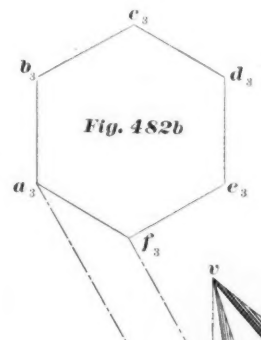


Fig. 482b

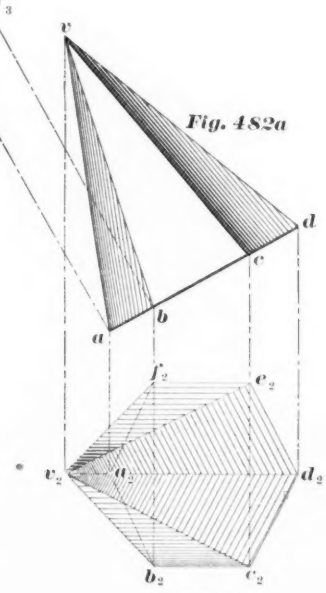


Fig. 482a

Fig. 482

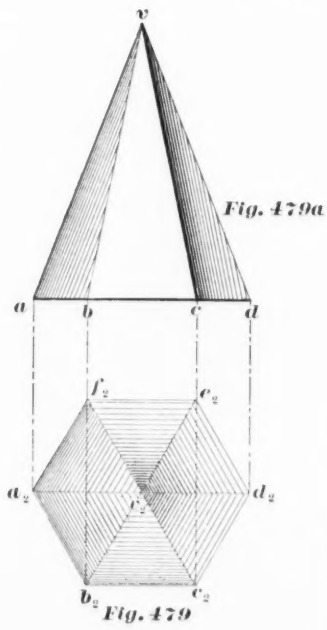


Fig. 479a

Fig. 479

parallel to the ground line, although the latter is not shown; but according to Art. 241 we know that lines in the horizontal projection, drawn parallel to the ground line, must be parallel to the vertical projection, and therefore our diagonal $a_2\ d_2$ must be parallel to the vertical plane of projection. The student will probably gain clearer conception of our remarks, by again reading and studying the twenty-fourth paper; with the practice he has had, or should have had, in drawing by this time, the principles given in the twenty-fourth paper may appear to him plainer than they did before, and be impressed more thoroughly on his mind.

571. In Fig. 480*a*, the distance (6″) given from v to h is the slant height, and not the length of the edges of the right pyramid; hence in some cases the following problem may present itself.

Problem 84.

572. *To find the length of the lateral edges of a right pyramid, whose projections are given as in Figs.* 480 *and* 480*a*.

Let $v\ g\ h$, Fig. 480*a*, be the vertical, and $g_2\ h_2\ i_2\ k_2$ the horizontal projection of a right pyramid; it is required to find the length of the lateral edges.

Through v_2 (Fig. 480) draw a horizontal line $e_2\ g_4$; from e_2 as a center, and with a radius equal to $e_2\ g_2$, draw an arc $g_2\ g_4$, cutting the line $e_2\ g_4$ in the point g_4. Through the point g_4 draw a vertical line, cutting the base $g\ h$ produced (Fig. 480*a*) in the point g_3; join the points g_3 and v by a straight line; the line $v\ g_3$ will be the length of the lateral edges of the given right pyramid.

Here, in order to find the length of the

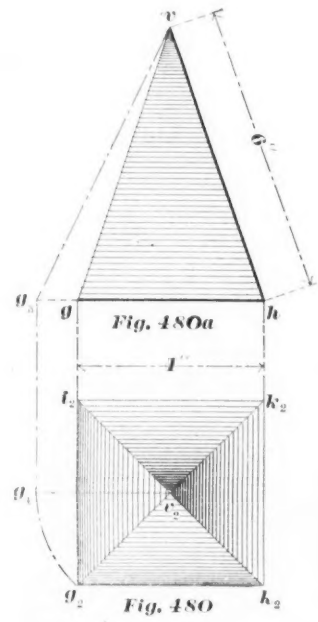


Fig. 480a

Fig. 480

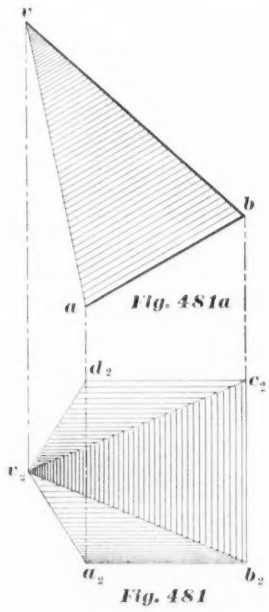


Fig. 481a

Fig. 481

edges, we have applied the principles given in Art. 332 (thirty-third paper).

If the same right pyramid is represented as shown in Fig. 474 (last paper), the line $V\ G$ or $V\ K$ will represent the correct length of the edges, and, of course, the construction given in this article is not needed.

573. Here it may be asked, should a pyramid be represented as shown in Fig. 480, or as in Fig. 474?

If the slant height is the most important part of the pyramid, we should represent it as shown in Fig. 480; if greater importance is attached to the length of the lateral edges than any other part, we should represent the pyramid as shown in Fig. 474; and if all the dimensions are of equal importance, we should represent it as in Fig. 480, because it can be so drawn more conveniently, and with somewhat less labor.

Directions.—In the space marked Prob. 84 draw a right pyramid having the dimensions given in Figs. 480 and 480*a*; find the length of the edges. Use 3-inch scale.

Problem 85.

573. *To find the horizontal projection of a right pyramid standing in an oblique position.*

It is required to find the vertical and horizontal projection of a right pyramid having a hexagonal base four inches across the sides, that is, in Fig. 482, the distance between the sides $b_2\ c_2$ and $f_2\ e_2$ is four inches. The length of the lateral edges $v\ d$, Fig. 482*a*, is seven inches. The axis of the pyramid and two of the sides of the base are to be parallel to the vertical plane of projection, and the plane of the base $a\ d$ is to make an angle of 30 degrees with a horizontal line.

We must first find the vertical projection of the pyramid. Draw the line $a\ b$ any length, making an angle of 30 degrees with any horizontal line. The line $a\ b$ will represent the plane of the base of the pyramid. Parallel to the line $a\ b$, and at any convenient distance above it, draw the line $a_3\ b_3$ (not shown in the illustration); and on this line as a diagonal, describe the hexagon $a_3\ c_3\ f_3$; the distance between the sides $b_3\ c_3$ and $f_3\ e_3$ must, according to the conditions given in the problem, be four inches. The method for drawing a hexagon in this position is given in Problem 42. Through the points a_3 and f_3 draw lines perpendicular to $a\ b$, cutting $a\ b$ in the points a and b; in a similar way find the points c and d. If, so far, this construction has been correctly made, then $c\ d$ will be equal to $a\ b$, and $a\ b$ or $c\ d$ will be equal to one-half of $b\ c$; because in any regular hexagon the sides, as $a_3\ f_3$, or $f_3\ e_3$, etc., are equal to the radius of a circumscribed circle (see Art. 109), and consequently $a\ d$, which, according to our construction, is equal to $a_3\ d_3$, must be equal to twice $b\ c$.

With a radius of seven inches describe from the points a and d two short arcs, cutting each other in the point v; join the points v and a, v and b, v and c, v and d, and thus complete the vertical projection of the pyramid.

Fig. 482. At any convenient distance below the line $a\ d$ draw the horizontal line $v_2\ d_2$; parallel to this line, and two inches below it, draw the line $b_2\ c_2$; also above the line $v_2\ d_2$, and two inches from it, draw the parallel line $f_2\ e_2$. Through the point v draw a vertical line, cutting the horizontal line $v_2\ d_2$ in the point v_2; through a draw a vertical line, cutting $v_2\ d_2$ in the point a_2; through b and c draw vertical lines, cutting the line $f_2\ e_2$ in the points f_2 and e_2, and also cutting the line $b_2\ c_2$ in the points b_2 and c_2. Lastly, through the point d draw a vertical line, cutting the line $v_2\ d_2$ in the point d_2.

Join the points a_2 and b_2, a_2 and f_2, d_2 and e_2, d_2 and c_2 by straight lines; the polygon $a_2\ b_2\ c_2\ d_2\ e_2\ f_2$ will be the horizontal projection of the base. The manner of finding the horizontal projection of this base is precisely the same as that of finding the horizontal projections of the bases of a prism shown in Fig. 242 (thirty-fourth paper). Lastly, join the points v_2 and b_2, v_2 and c_2, v_2 and e_2, v_2 and f_2, thus completing the horizontal projection of the pyramid.

Directions.—Fasten a fresh sheet of drawing-paper, divide it as before (Art. 124), and mark the spaces Prob. 85, 86, etc. In space 85 find the vertical and horizontal projections of a pyramid, as shown in Figs. 482 and 482*a*; the axis of the pyramid and two of the sides of its base are to be parallel to the vertical plane of projection. The base of the pyramid is to make an angle of 45 degrees with a horizontal line. The base is to be a hexagon three inches across the sides; the lateral edges are to be six inches long. In the same space find the vertical and horizontal projections of a right pyramid, having a base three inches square. The base is to make an angle of 30 degrees with a horizontal line; the length of the lateral edges is to be six inches; axis of the pyramid, and two of the sides of the base, are to be parallel to the vertical plane of projection. Under these conditions the projections of this pyramid will appear like those in Figs. 481 and 481*a*; but since in the latter figure the lines $v\ a$ and $v\ b$ will represent the slant height, and not the length of the edges, it will be necessary to find, on a separate piece of paper, the slant height. The manner of finding this slant height is the reverse of that for finding the length of the edges given in Problem 84. After this slant height has been found, the mode of procedure is the same as in the last problem.

Details of Sweet's 16-inch Engine Lathe.

BY PROF. C. I. KING.

I.

Fig. 1 represents a longitudinal section of the head stock, in which the construction is clearly shown. The arbor *A* has a peculiar arrangement of screw for holding the face plate, the threads being cut parallel, but at the end and shoulder tapers are made, which have their counterparts in the face plate. The plate is not fitted closely in the thread, the fit coming at the two tapers and shoulder. The collar and bevel wheel *a a* are screwed to the arbor, and have no tendency to unscrew, as the lathe runs in one direction only. The steel spider *S'* is keyed to the arbor, and has two trunnions projecting from diametrically opposite points with their axes parallel to the arbor, which carry the four spur wheels *b b b b*. The hubs of the two smaller wheels project far enough to carry the two larger ones to which they are keyed. The small wheels engage with the internal wheel referred to as part of the disk *D*, the larger ones being driven by the sleeve *S*, to which the cone is keyed. When the gears are not in use, the disk *D* is drawn up to the end of the cone, and the gear, train, arbor and disk all turn together, the handle *H* being in the position shown at Fig. 2. When the gears are used the handle is in the position shown at *H*, Fig. 1. The trunnions of the spider are supported at the ends by a continuous ring, shown at section *R*, the ring being fastened at two raised surfaces 90° each from the trunnions. In drilling the trunnions for the screws, the holes were drilled into the bottom, forming reservoirs *o o* for oil. The hole was continued with a smaller drill for a short distance, and was then connected with the outside of the spider by a hole *o'*, drilled at an angle to coincide with a hole *o''*, drilled through the disk, hole *o''* being large enough to allow the oil-can to reach through to *o'*. A plan of the spider and ring is shown in Fig. 6, with section in Fig. 7. The section of the spider *S'*, shown in Fig. 1, is at *A B*, Fig. 6, and the section Fig. 7 is *C D* of Fig. 6. The serrated surfaces shown at *t* (Fig. 1), were originally intended to represent threads, so that, by throwing out the blocks, one of which is shown in section *t'*, the disk *D* would be screwed up against the end of the cone, thus throwing out the gears. It will be seen that disk *D* is shown drawn close to the inner nut of the hub which carries the main arbor bearing, and also that the hole through it is a double taper. The steel box projects through the casting a distance equal to one-half the thickness of the disk. This and the hub of the spider have a taper equal to those of the disk. When in position it will be seen that *D* has no contact with the spider at its hub, which revolves with the arbor, therefore no wear occurs. When the disk gears are out of action the disk is drawn to the taper on the hub of the spider, and all wear is avoided on that side. As the lathe was constructed, parallel grooves were substituted for threads, and the movement of the disk to the cone was caused by a lack of coincidence in their position. The handle *H* is fast to the shaft *E*, having an eccentric turned on its inner end with a short bearing beyond. This eccentric passes through the block *t'*, and throws it up and down. *H* also has a projection on its opposite end, and when in the vertical position it is drawn into the groove *g'*. On this same shaft, and against the inner side of the handle, is a small wheel *g*, let into the surface of *D* by a counterbore. This gear engages with a continuous ring *r*, Fig. 1, having enough teeth cut on it for a half revolution of *g*. This device is duplicated, minus the handle, at points *g g*, Fig. 2, shown in dotted lines. On the end elevation of the head stock, Fig. 2, the ring *r* is shown with spiral slot, and sliding bolts *b b*, as shown at *b b*, Fig. 8. Two of these bolts were used, and, when thrown out, passed into a square slot shown in section of head stock at *b'''*, Fig. 9. It will be observed (Fig. 2) that by moving *H*, rotary motion is imparted to ring *r*, and by it to *g g*, which turns the three eccentrics which slide the three blocks up and down. A section of *D*, through the position of the blocks, is shown in Fig. 8. Coincident with these movements the bolts slide back and forth-which disengages gears *a a'*, Fig. 1. A transverse section through the center of shaft *S'*, Fig. 3, shows the connection at this point. The collar on which the head stock swings when boring tapers is shown at *c'*, Fig. 1. The lower end of shaft *S'* is square, and fits a bevel gear supported in position in the bed casting.

I wish to call special attention to the centers of this lathe, as I believe them better than the taper center. When they were introduced here I thought the idea original, but have since found them in use on the head stock end of jewelers' lathes. Not, however, for their own merit, but to conform to the spring chucks, and to interchange with them. This much may be said of them, however, that they will remain tight in place. They can always be cleaned at the angle, and if there are any particles of dirt in the holes, the center will clean it out when put in place, and it can be taken out and put in indefinitely, and run true.

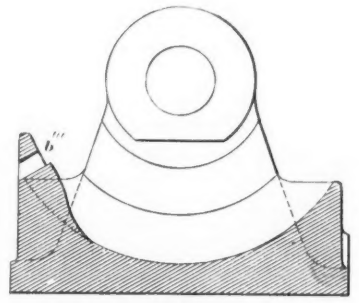


Fig. 9. SECTION A B.

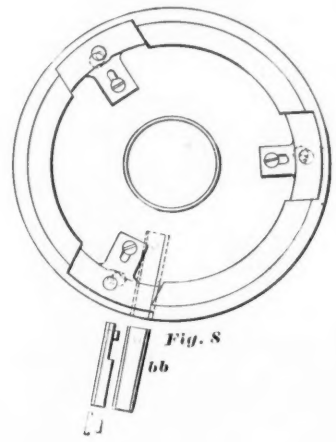


Fig. 8

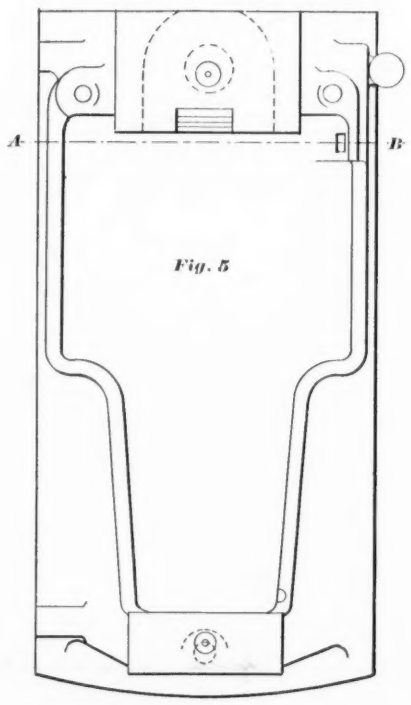


Fig. 5

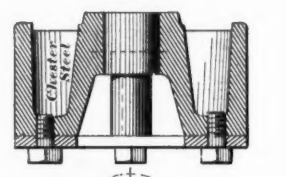


Fig. 7

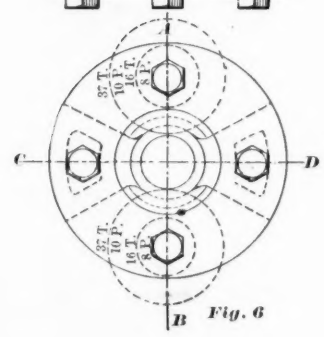


Fig. 6

Overhead Cone Sizes 11¼" 9¼" 8 5/16" 6 11/16" 5⅛"

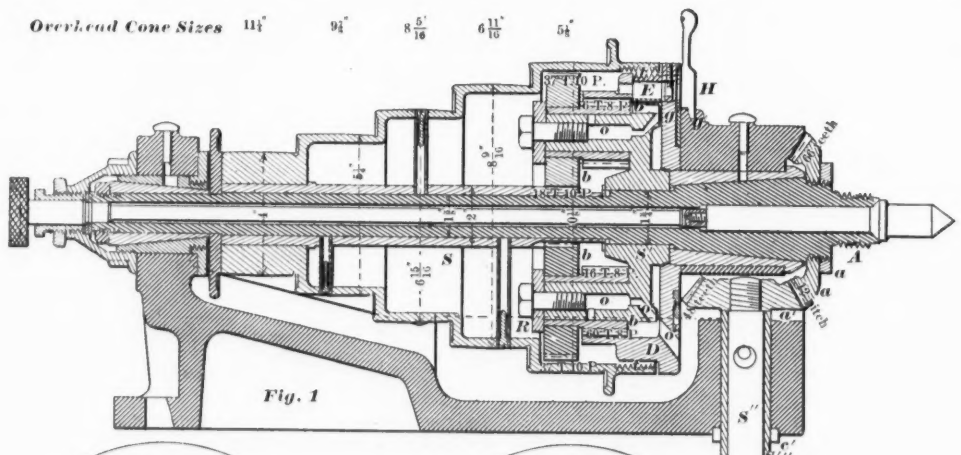


Fig. 1

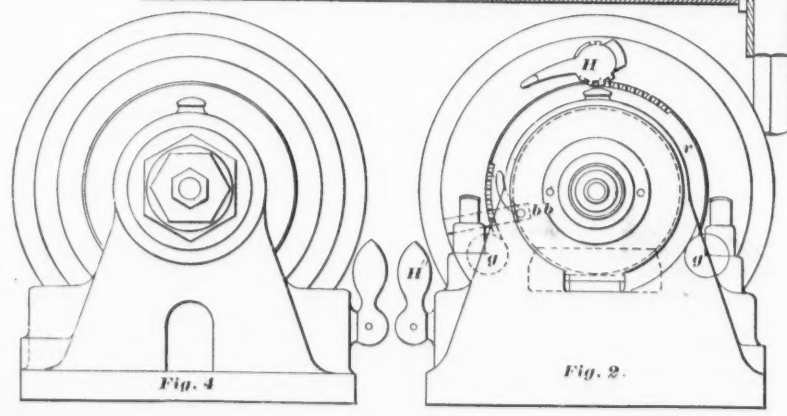


Fig. 2.

Fig. 4

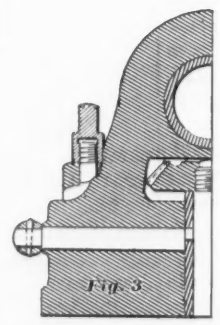


Fig. 3

This looks pretty complicated, but there is a grain of consolation as part of the dose ; the wrench used to get the gears out and in never gets lost, and the belt never gets caught in the gears.

The portion of the section (Fig. 1) lying under the main bearing, shows the vertical shaft *S''*, and gear by which motion is imparted to the screw gears. This shaft runs in the sleeve *S'''*, which also has a vertical motion imparted by handle *H''*, Fig 2, and

Nails from Tin-Scrap.*

BY OBERLIN SMITH, BRIDGETON, N. J.

(A paper read before the American Institute of Mining Engineers.)

It may surprise the learned metallurgists who read this paper to learn that, by a recent discovery, nails of good quality can be made at one operation, directly from the ore, at the rate of, say, sixty per minute for each operator. It should be stated, however, that the raw material referred to does not answer strictly the ordinary assayer's definition of an ore. It is found, in strata of various thickness, in Harlem, N. Y., and other localities where the *debris* from restaurants and from sheet-metal factories of various kinds has been dumped. In other words, it is old and new tin-scrap—one of the few substances which this generation, mainly occupied in exhausting the accumulated resources of the past, seems to have laid up, by way of atonement, for the benefit of posterity. In speaking of this material as *ore*, we are simply looking forward, prophetically, to the time when our descendants may dig it up and write learned papers for the American Institute of Mining Engineers upon the best methods of assaying and smelting it.

At least such has seemed to be its destiny hitherto. It may fairly be said that the many attempts which have been made to utilize it by separating, through chemical or electrolytical processes, its two valuable constituents, metallic tin and first-class wrought-iron, have failed, either technically or commercially. The reasons for such failure need not here be discussed. Either the separation has been incomplete, the iron still retaining enough tin to spoil it for the sinking-fire, or other use short of re-melting (perhaps even for that), or the manipulations of the process have been too expensive to make its results profitable—or both. Meanwhile the great tin-scrap deposits have gone on growing faster than any other strata of our post-tertiary psychical era ; given up by metallurgists, not yet attacked by geologists, and explored only by that mining engineer of the transitional period, *Gulielmus Caper*.

Before leaving these heaps of tin-scrap, however, to become mere mineral deposits for future ages, it may be well to consider a novel plan for their immediate utilization—novel, not only in its means, but in its principle. For it undertakes to use this material just as it is, without trying to separate its constituents at all, and to use it, moreover, for a purpose in which the qualities of both these constituents, namely, the tensile strength and ductility of the iron and the resistance of the tin to corrosion, are directly employed with advantage. I refer to the manufacture, by mechanical pressure, of nails.

This nail was invented, in its original shape, by Mr. Geo. H. Perkins, of Philadelphia, and has been developed, through various forms, until it has almost reached a commercial stage—the machine in which it is to be made, in marketable shape, being nearly completed. The writer has been associated with Mr. Perkins in its development, and can, perhaps, make interesting a brief description of the troubles we have gone through in order to produce it quickly, at one operation, in a reasonably manageable and durable machine.

The first scheme tried was to cut "blanks" from ordinary tin-plate and sheet-iron scrap, of an approximately rectangular form, about

* Since this paper was read, the nail machine referred to has been completed, and gives results beyond all anticipations regarding it. One especially valuable feature is its capacity for "chewing up," so to speak, all sorts of slivers and small pieces of scrap, without danger of clogging the mechanism.

three-quarter inch wide by one and three-quarter inches long, similar to the plan shown in actual size, Fig. 2, but having the end section *A*, Fig. 1 (drawn about twice its real size). This was done in an ordinary press. By a second operation, it was corrugated into the form *B*, Fig. 1, in another press, with a special automatic die, which corrugated the middle grooves first and the side grooves afterwards; much of the metal used not proving strong enough to stand the friction of being pulled into the corrugations of the die without cracking. At a third operation, the embryo nail was crushed together into the form *C*, Fig. 1 (but more tightly closed), something after the manner of closing an accordion bellows. These headless nails were then fed by hand into a revolving dial, to carry them under a heading mechanism, after the operation of which they were ejected from the machine automatically.

Obviously, this series of separate operations made the nails far too expensive for the market; and, moreover, some trouble occurred from their splitting in the tightly folded corrugations. We afterwards built an *automatic* machine which performed all the above operations in succession, delivering a complete nail at each stroke. It was, however, far too complicated for practical use, and simply served to show what could *not* be done.

Our second nail machine proper, constructed to receive blanks which had been already cut in an ordinary press, worked fairly well. It was likewise an experimental machine, built "piece-meal" and not strong enough for continual hard work; but it served this time to show what *could* be done. Instead of working upon the principle of regular corrugations, it simply crushed up the blanks edgewise into any form which they chose to assume—the end sections appearing somewhat as shown at *D*, Fig. 1. The blank and finished nail are shown in Fig. 2.

The machine now under construction has been very much simplified and is enormously strong and heavy. It is adapted to cutting, crushing, gripping and heading the nails at one operation, and can be run as fast as an expert operator can feed the material. Its feed probably varies with jagged, irregular scrap, from thirty to ninety nails per minute, although straight strips of sheet-metal can easily be fed by hand into a machine running as high as 240 strokes per minute.

During the course of our experiments, various forms of nails have been tried. Among others were straight cylindrical nails with conical points; straight square nails with pyramidal and with wedge-shaped points; hexagonal nails, etc. The most practical form, however, seems to be the square taper nail shown in Fig. 2, which has about the same shape as the ordinary cut nail, but is somewhat stronger and a good deal tougher. It is well adapted for all ordinary purposes, but is especially suitable for a roofing nail, since the tin coating prevents much rusting, and is good to solder to.

Among other processes, we have tried winding the nail blank upon itself, after the manner of a window shade, but minus a mandrel. This makes a very good round nail.

The economy of this system of nail-making is obvious. The scrap can be bought for about seventeen cents per 100 pounds, and a boy can make perhaps 100 pounds of nails per day. The most economical system of manufacture will probably be to run one or more nail machines at each large "tin shop," set as close as possible to the presses which produce the scrap, so as to avoid the expense of unnecessary handling, and the extra tangling up incident thereto.

According to the Paris correspondent of the London *Times*, the Eiffel Tower should be known as the Nouguier Tower, for that is the name of a young engineer in Mr. Eiffel's employ who first conceived the idea, and, with the help of a friend, who was an architect, developed it and worked it out.

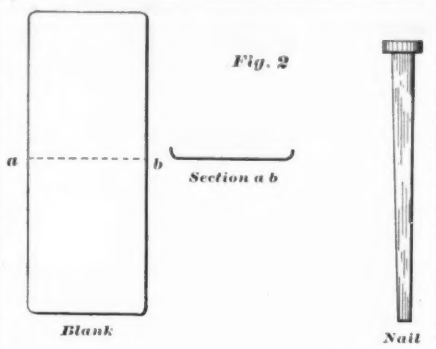
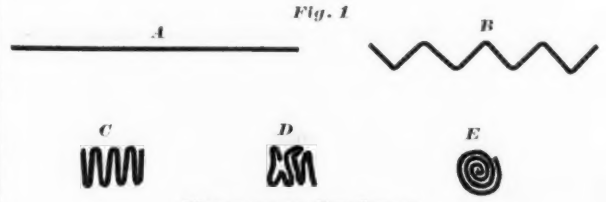


Fig. 1



NAILS FROM TIN-SCRAP.

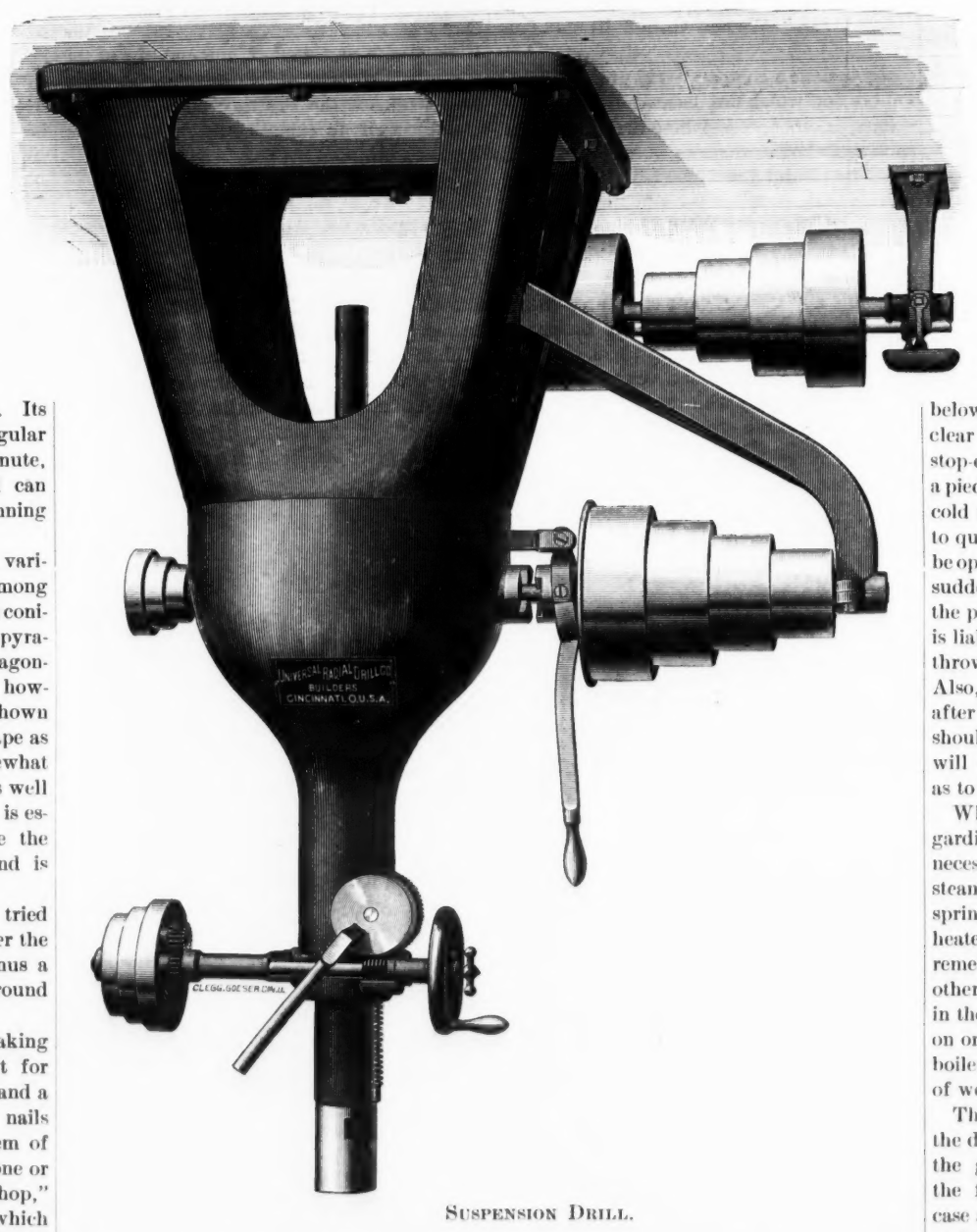
Suspension Drill.

With this we present an engraving of a suspension drill, which, besides being heavier and more powerful than machines of its class usually are, has some points of design which we think will commend it to those competent to judge of such matters.

The extreme distance from the supporting timbers to the lower end of the spindle is something over 6 feet. The cones are for a 4″ belt, and there are gears inside the cone, which can be thrown in or out of action without stopping the machine, by the lever shown at the right. The spindle is 2¼″ diameter, has 20″ vertical travel, quick return, geared automatic feed, and is counterbalanced. It will be noticed that the frame is so designed as to secure great rigidity, and that it presents a very neat appearance.

The machine has been designed with a recognition of the fact that machinists usually look upon a suspension drill as something in the nature of a necessary evil; but, in the belief that where the nature of the work demands such a machine, it pays to have a good one.

The builders are the Universal Radial Drill Co., Cincinnati, Ohio.



SUSPENSION DRILL.

The Modern Steam Plant and its Management.

BY PETER H. BULLOCK.

STEAM GAUGES.

There is before me a steam gauge spring marked 191,784, which is the consecutive number of this gauge made by a single company in the United States. There are many makers of gauges, and the total number in use in the country must be among the millions. There are very few instruments or machines upon the accuracy of which so much blind dependence is placed as upon these same steam gauges. The figure at which the index stands is by most people taken without question as the actual pressure. How much foundation there is in fact for this confidence, very much depends upon the previous history of the gauge in question. If it was originally well made, properly attached, and has had good care, it is quite likely that it is still reliable; but if it is of doubtful parentage, or was improperly attached, and has been recklessly used, it may still be right, but it is very doubtful; and, when put beside a test gauge, the chances are that it will be 10, 20 or 40 pounds + or —, as the case may be.

Probably all are familiar with the Bourdon spring, and the Lane, Ashcroft and Crosby improvements. The principle upon which they all work is the straightening of a flattened and curved tube under internal pressure. The slight motion of the free end of the spring tube is transferred, by means of levers, segments and pinions, to the spindle that carries the index hand. The amount of movement of the free end of the spring is dependent upon its length and thickness. In hydraulic gauges they are made of steel and are heavy, while for light pressures and vacuum gauges they are of composition and quite light. The most familiar example that will illustrate the action of the spring is the straightening of fire hose when under pressure.

There are also gauges that are operated through suitable gearing by the pressure acting against a diaphragm in contact with an involute spiral spring. In all, however, the movement of the spindle is multiplied several times over that which moves it, and any imperfection in the connections will consequently be magnified more or less in the movement of the pointer.

A first-class gauge has gears and levers as finely made as any clock movement. The case is brass, and is threaded on the outside edge for the glass frame, which has a good clear disk of glass cemented into it, and is screwed onto the threaded part of the case, which it fits nicely. This excludes all dust and dirt from the interior works. The dial will be a stiff piece of plated brass held in place by four screws. The gauge should be put up firmly, but with care that the screws do not spring the case by drawing it across any oval surface. It should be piped with the union joint next to the gauge, and the stop-cock below that. This permits the gauge to be taken down at any time for testing. There should be no other valve or cock between it and the boiler, and the pipe should not be connected to the steam pipe or any part of the boiler where there are liable to be sudden changes and vibrations in the pressure. There must be a siphon or trap of water under the gauge, and there should be a pet-cock in the lowest part of the pipe for drawing off the water when necessary. If the pipe is of iron, this should be done frequently, but if of brass, very seldom will do. When thatis done, close the stop-cock below the gauge, open the pet-cock, and when clear steam comes, close it, but do not open the stop-cock for some minutes. It is well to twist a piece of waste around the pipe and pour some cold water onto it, which will cause the pipe to quickly fill, and then the stop-cock should be opened again, but very slowly. Avoid all sudden jars to the gauge, especially letting the pressure on or off from it quickly, which is liable to slip the index on the spindle or to throw the pinion and segment out of gear. Also, when the gauge is to be taken down, after shutting off the stop-cock the union should be loosened slowly, so that the pointer will not fly back against the pin so suddenly as to slip, bend or break it.

Why so much care has been enjoined regarding water in the siphon is that it is necessary that it should be there, and not steam. It is probable that no steam gauge spring is ever as reliable after it has been heated as it was before. It should also be remembered that heat may come from any other source and do as much harm as steam in the spring, and no gauge should be located on or near a flue or other heated part of a boiler without a liberal air space and a block of wood behind it for its protection.

The cheap gauge will have an iron case, the dial will be thin and held by two screws, the glass will be rough in surface and cut, the frame that holds it is slipped over the case and held by screws. Inside there is the spring lever and gears, but they hold about the same relation to the works in the best gauge as does a Waterbury watch to a chronometer. They may register the pressure about right, the same as the watches referred to may keep pretty good time, but they are short lived, and there is always a doubt about them that is not felt with the best gauges.

One of the important things about a gauge is to see that no dust or dirt gets into the case and gums up the gears. A very small

particle will often cause the gauge to register many pounds wrong.

A gauge should be selected that has a dial marked for about double the pressure proposed to be carried. This gives a fair movement to the parts, and, as usually made, leaves the pointer about vertical when at the pressure required, which is quite convenient when the gauge is in a dark or shaded place.

Trial of a Galloway Boiler.

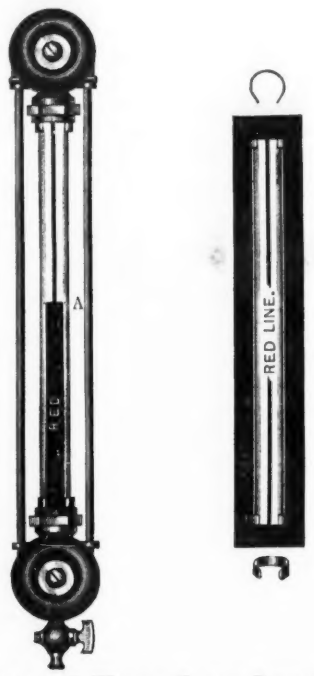
The following data of the trial of a Galloway boiler will be of interest to our readers. The boiler was made at the Edge Moor Iron Works, Wilmington, Del. The trial was conducted by George H. Sellers, general superintendent of the Edge Moor Works, and Walter Laidlaw, general superintendent of the Laidlaw & Dunn Company, of Cincinnati, Ohio. The data below will explainitself:

TRIAL OF ONE 7'X28' GALLOWAY BOILER AT HUNT STREET PUMPING STATION, CINCINNATI, OHIO.

Date of trial		May 1st, 1889.
Duration of trial	hours.	10
Height of stack	ft.	150
CONDITIONS.		
Grate surface	sq. ft.	36.25
Water heating surface	"	960.00
Super heating surface	"	199.00
Total heating surface	"	1159.00
Ratio of grate to water heating surface		1-26.48
Steam space in cubic feet	cub. ft.	211
Water space in cubic feet	"	482
Total steam and water space in cubic feet	"	693
AVERAGE PRESSURES.		
Force of draught in front of boiler chamber	in.	11.32
Absolute steam pressure	lbs.	107.2
Atmospheric pressure per barometer	in.	29.35
Steam pressure by gauge	lbs	92.80
AVERAGE TEMPERATURE.		
Of external air	deg.	64.94
Of boiler room	"	67.57
Of flue escaping gases	"	Melted lead.
Of back of boiler chamber	"	Melted zinc.
Of feed-water in tank	"	61.05
Of feed-water entering boiler	"	193.70
FUEL.		
Total amount coal consumed (including 250 pounds of wood = 100 pounds coal)	lbs.	7149
Total refuse from coal	"	736
Moisture in coal	"	238.06
Total amount of dry coal	"	6910.94
Dry coal consumed per hour	"	691
Total amount of combustible	"	6173.94
Combustible consumed per hour	"	617.39
CALORIMETER TESTS.		
Quality of steam, dry steam taken as unity	%	1.110316
WATER.		
Height of water over fire tube	in.	7.44
Total water pumped into boiler and apparently evaporated	lbs.	65446
Water actually evap.—corrected for quality of dry steam	"	72665.74
Equivalent water evap. into dry steam from and at 212 degrees	"	77105.08
Equivalent water evap. into dry steam from and at 212 degrees per hour	"	7710.5
Equivalent water evap. into dry steam from 212 degrees and at 335 degrees per hour	"	7421.7
Imparted to water in boiler	B. T. U.	74195353.827
Imparted to water in fuel	B. T. U.	265028.865
Equivalent total heat derived from fuel		
In British thermal units, total	B. T. U.	74460382.692
Equivalent total heat derived from 1 pound of dry coal	B. T. U.	10769.936
Equivalent total heat derived from 1 pound of dry combustible	B. T. U.	12055.57
ECONOMIC EVAPORATION.		
Water actually evap. per pound of dry coal from actual pressures and temp.	lbs.	9.47
Water actually evap. per pound of combustible from actual pressures and temp.		10.6
Equivalent water evap. per pound of dry coal from and at 212 degrees	"	11.15
Equivalent water evap. per pound of combustible from and at 212 degrees	"	12.488
Equivalent water evap. with one-sixth refuse at seventy pounds gauge pressure from temp. of 100 degrees F. Item 44, x 0.7249	"	9.05
RATE OF COMBUSTION.		
Dry coal actually burned per sq. ft. of grate per hour	"	19.05
Consump. dry coal per hour, coal assumed with one-sixth refuse. per sq. ft. grate surf.	"	20.43
Consump. dry coal per hour, coal assumed with one-sixth refuse. per sq. ft. heat surf.	"	.639
RATE OF EVAPORATION.		
Water evap. from and at 212 degrees F. per sq. ft. of water heating surface per hour	"	8.03
Water evap. per hour from temp. of 100 degrees F. into steam at 70 lbs. by gauge per sq. ft. grate surf.	"	185.0
Water evap. per hour from temp. of 100 degrees F. into steam at 70 lbs. by gauge per sq. ft. water heat surf.	"	6.98
Kind of coal used		Yough. Nut 5-32
Damper open		
Cleaned fires No. times each furnace		Twice.

"American" Water Gauge Reflector.

Though engineers hold varying opinions as to the general superiority of the French Red-line reflecting gauge glasses over the well-known Scotch glasses, all will agree that the reflecting feature of the former is a decided advantage. It has upon it a narrow red line, the width of which is greatly magnified by the water in the tube, so that the water appears to be a bright red liquid, and can be



"AMERICAN" WATER GAUGE REFLECTOR.

easily seen at a comparatively great distance. On boilers which are located in basements, cellars, or other places where the light is poor, such as on board steamers, in mines, etc., this has been found a decided help to the engineer, yet there are those who maintain that the Scotch glass has other advantages which more than compensate for this, and the device which we illustrate herewith is intended to enable any kind of glass to be used which may be preferred, and yet secure the advantage of the red-line reflecting glass.

It consists of a thin, concave strip of copper, coated all over with white enamel, and having a longitudinal red stripe. This strip fits to the back of the glass, and is held in proper position by two small steel clasps, which partly encircle the glass. The effect is just the same as with the French glasses, and the favorite glass can be used, whatever it may be.

It is made by Pancoast & Maule, Philadelphia, Pa.

No Luck About It.

We take the following from *The Woodworker :*

The boilers in Foster's box factory, Racine, Wis., exploded a couple of weeks since, seriously injuring Mr. Foster and the engineer and wrecking about half the building. This is hard luck, as the factory was burned last fall and had only got fairly started to work after being rebuilt.

The thing wrong with the above is the gist of the whole matter. There was no luck about it. On the part of some one it was organized disaster.

LETTERS FROM PRACTICAL MEN.

A Handy Protractor.

Editor American Machinist:

The following device is submitted, with the hope that it may prove useful to my fellow craftsmen. I have never seen a similar contrivance, and therefore publish it for the use of draftsmen if they may deem it worth the time of making one.

The required parts for this protractor are a T square or straight-edge and two triangles, one large and one very small; 45° triangle will be found convenient for the graduations. Place the two triangles as shown in Fig. 1, and draw a line across both, marking this line zero on the larger triangle. Moving the triangles to the position shown in Fig. 2, draw a new line on the larger, to match line on the smaller, and mark line on larger for the two angles given. Continue this graduation until all the angles for one quadrant are determined.

For the other quadrant it will be found more convenient to turn the larger triangle over, and graduate on the other side.

This protractor is dependent for its correction on the original graduation, and on the care with which the edges and corners of the triangles are protected. If the material of the triangle is of such nature as to stand the general work of the drafting office, it ought equally well to stand as a protractor for similar work.

A. STRATZ.

Fig. 1

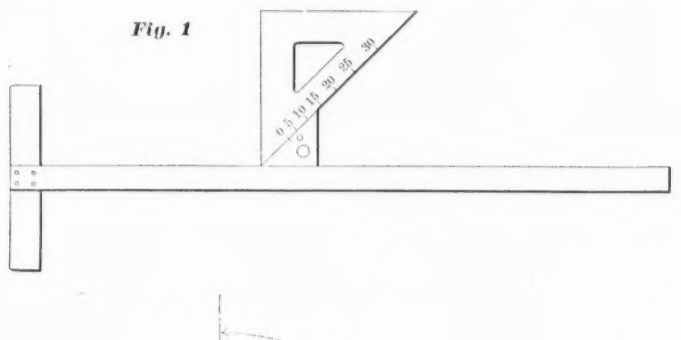
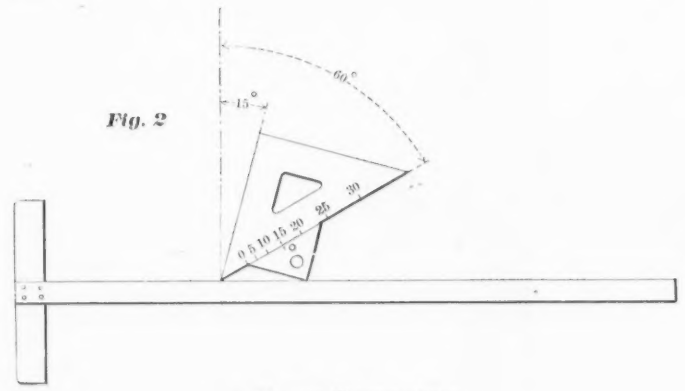


Fig. 2



A HANDY PROTRACTOR.

Tools for Brass Works.

Editor American Machinist :

In your issue of May 23d H. E. W. opens the long neglected subject of tools for brass work. His left-handed spiral flutes for reamers is a good scheme, but I think his idea of finer teeth is wrong; we have some with *three teeth* only, cut straight, that give good satisfaction, and are "backed off" to within a sixteenth of the cutting edge. From this point we give just lead enough to cut; the chips or shavings reamed out will fill in the grooves and prevent chatter. We also use many flat reamers, just a flat piece of steel ¼ inch thick, and hold it in a slotted holder in the back head of a fox lathe; these, however, are used mostly for roughing out, though by the use of "splines," *i. e.*, hard wood strips, to lay on the reamer and fill the hole, they will ream very nicely.

Did H. E. W. ever see a reamer with a left-handed square thread cut the whole length of the flutes? You would hardly think they would make a smooth hole; but they do, as the pitch of the thread cuts out any mark that the teeth might leave. His remarks on dies are hardly clear; of course they should only bear enough to steady them; but how much is that? "Well cleared," as considered for "iron" dies, will not work well on common brass, but will "tear" the thread; has not bearing enough. On the tougher brass it might work, but on the common cast metal our experience has been that it should bear well from two-thirds to three-quarters of the circumference, and even a little squeal doesn't injure it any; better that than strip the thread.

I would like to ask H. E. W. if he has ever used flat taps for turret work; if so with what result?

We have a new scheme in dies, which we think about right, and will illustrate it before long, but hope others will keep up the "brass" talk, as it is a neglected brand.

Phila., Pa. FRED H. COLVIN.

West's Testing Machine for Cast Metals.

The machine illustrated on page 7 is one that has been perfected by the well-known writer on foundry matters, Thomas D. West. It is manufactured by the Thos. D. West Foundry Company, Cleveland, Ohio. It possesses many original features calculated to adapt it to the use of founders and manufacturers of machinery. Attention will first be called to the arrangement shown at *A*, designed for ascertaining the contraction of the metal. This gauge is made on an incline of a half inch in five inches, and is graduated so as to be readily read in hundredths of an inch, and slides in planed bearings so as to insure accurate work. *B* shows the test bars resting in place for measurement. These bars are cast round instead of square, and of an area equal to one square inch. The reason for casting them round is to insure uniformity in cooling, most favorable to overcome any chilling that might take place in the corners were square bars used. The patterns for these round test bars are turned out of wrought-iron to a standard gauge, and have depressions on the ends for convenience in testing. In moulding the test bars, special attention is called to the original design of flask and methods adopted for moulding, and to the necessity for accurate work. In the ends of the flask, which is all iron, are flanges which form the ends of the mould. The distance between these flanges is made to correspond with the points *R* and *S* when the gauge *A* is at 0, Fig. 1. By this plan it will be readily seen that the length of the mould cannot be varied by any rapping of the pattern which the moulder might do; so, as far as the moulds are concerned, reliance can be placed in their always being exactly the same length. The flask is of a handy design, and made so as to permit the casting of two tensile and two transverse bars at one pouring. To save joint making, a "hard match" mould-board is made to go with the flask, and which serves as well as a receptacle for holding the patterns and preventing their getting lost. Should parties desire the flask and attachments, independent of the testing machine, they will be furnished with the device for measuring the contraction attached to the flask.

When testing for transverse strength the test bar is placed in the stocks *D*, *D*, and the load applied by means of the wheel *E* and lever *F*, and weighed by the scale beam *H*.

Two forms of machines are constructed—one is as shown in the cut, and the other is made having only a single weighing beam *K*, the beam being longer, thereby saving the use of so many weights.

The machine is constructed so that, when desired, the scale beam can be readily lifted from the machine and be used for outside weighing, by suspending it on a hook made for that purpose. This, for works that have no wagon scales, or that may desire to weigh loads a distance from any scale, might often be desirable. In removing the weighing beam from the machine, all that is required to be detached is the pin at *T*, and when replaced on the bearings *W*, and the pin *T'* inserted, all is again ready for testing purposes.

For measuring the deflection or elongation of metal, the gauge seen at *M*, and worked upon the same principle as that described and seen at *A*, is used.

For testing the tensile strength of cast metal, the test bars, when for cast-iron, are made round, and of a diameter to give an area of one-half of a square inch. For steel or similar strong metals that can be cast in moulds, the test bars are made round, and of a diameter to give an area of one-quarter of a square inch.

The tensile test bars are cast of such a form that, when held by round $\frac{3}{4}$" pins inserted in holes at their ends, and set in the stirrup *N*, and a casting made so as to slide into jaws at *P*, there is absolute freedom in permitting the test bar to adjust itself centrally, insuring a uniform pull over its entire breaking section.

In order to know if the test bars are "strained" in the casting of them, and allow for same in ascertaining their strength, gauges seen at *V* are so arranged that, by measuring with the sliding scale *A*, the one five-hundredths of an inch difference in the diameters can be detected. The largest step or gauge is used for the transverse test bar, the middle gauge for the cast-iron tensile test bar, and the smallest gauge for the steel or strong metal test bars. By means of these gauges the expense of turning up test bars to insure absolute diameter can, for most practical purposes, be dispensed with.

To insure the weighing beam working level and accurate while testing material, the arm *X* is pivoted so as to raise the end at *T* the same height the end at *W* may raise. The construction of the machine and weighing beam or scales is such as to admit of easy and safe transportation.

Regarding the importance of testing cast metals, Mr. West writes as follows:

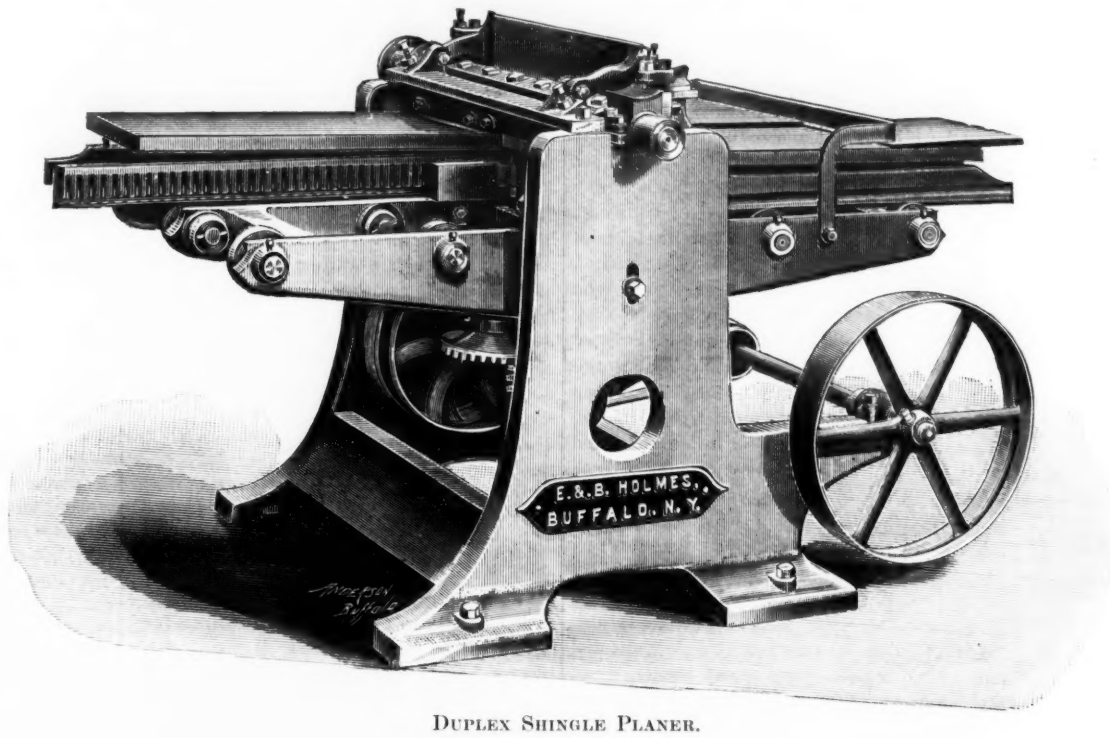
It should be encouraging to engineers, foundrymen and machine builders, to note the present interest that is being manifested by many in ascertaining the strength and results obtained from mixtures of metals. It is comparatively a new departure of investigation for most of those at work testing, and one that is sure to inaugurate many radical changes from the present practice. There are many things about metals that we do not know or understand, and few of us realize what a field there is before us for investigation, and the benefits to be derived therefrom.

One thing, which to the writer appears as valuable to understand and have record of, as the tensile or transverse strength of cast-iron, but which is ignored at the present day, is that of contraction, commonly called shrinkage.

What does it avail in the construction of cast-iron machinery desired to have strength, should the iron be fair and strong, yet high in contraction? Nearly all castings have more or less internal strains existing within them, and were it not for the elasticity of the iron, permitting in a degree a stretching of the metal, most all would crack or fly in pieces, as many castings do when subjected to a blow, or to the strains incident to the operation of machinery. The following may serve to show what an important factor contraction is:

Take for example a pattern 14 feet long, 4"x9", and cast alongside of it at the same time and of *the same iron* a piece 14 feet long, 2"x$\frac{1}{2}$", and when the castings are cold the light one will be found to have contracted about as much again as the heavy one. This, which is a fact and can be proven by anyone that may wish to test it, ought to be sufficient to awaken thought to a factor which, in the writer's estimation, is as important to the life and durability of a machine as is the strength of the iron of which it is made.

Again, some irons contract a great deal more than others. To day a long casting may be made, and to-morrow the same piece cast again with no intended change in the mixture of the iron. Should the mould be 12 feet long, it is not an uncommon occurrence to find from $\frac{1}{4}$" to $\frac{3}{8}$" difference in the length of the casting, as is often seen in columns. To keep down the contraction to a minimum is certainly desirable, and in the near future, I feel safe in saying, will be more valued than it is at the present day.



DUPLEX SHINGLE PLANER.

It was Unintentional.

Our esteemed English contemporary, *Mechanical Progress*, quotes the AMERICAN MACHINIST in its April 30 issue with due credit, which is common courtesy, and appreciated accordingly. But in the same issue it publishes an article on "The Modern Steam Plant and its Management," written expressly for us by Peter H. Bullock, and fails to give any credit whatsoever. Of course this is unintentional on the part of our contemporary.

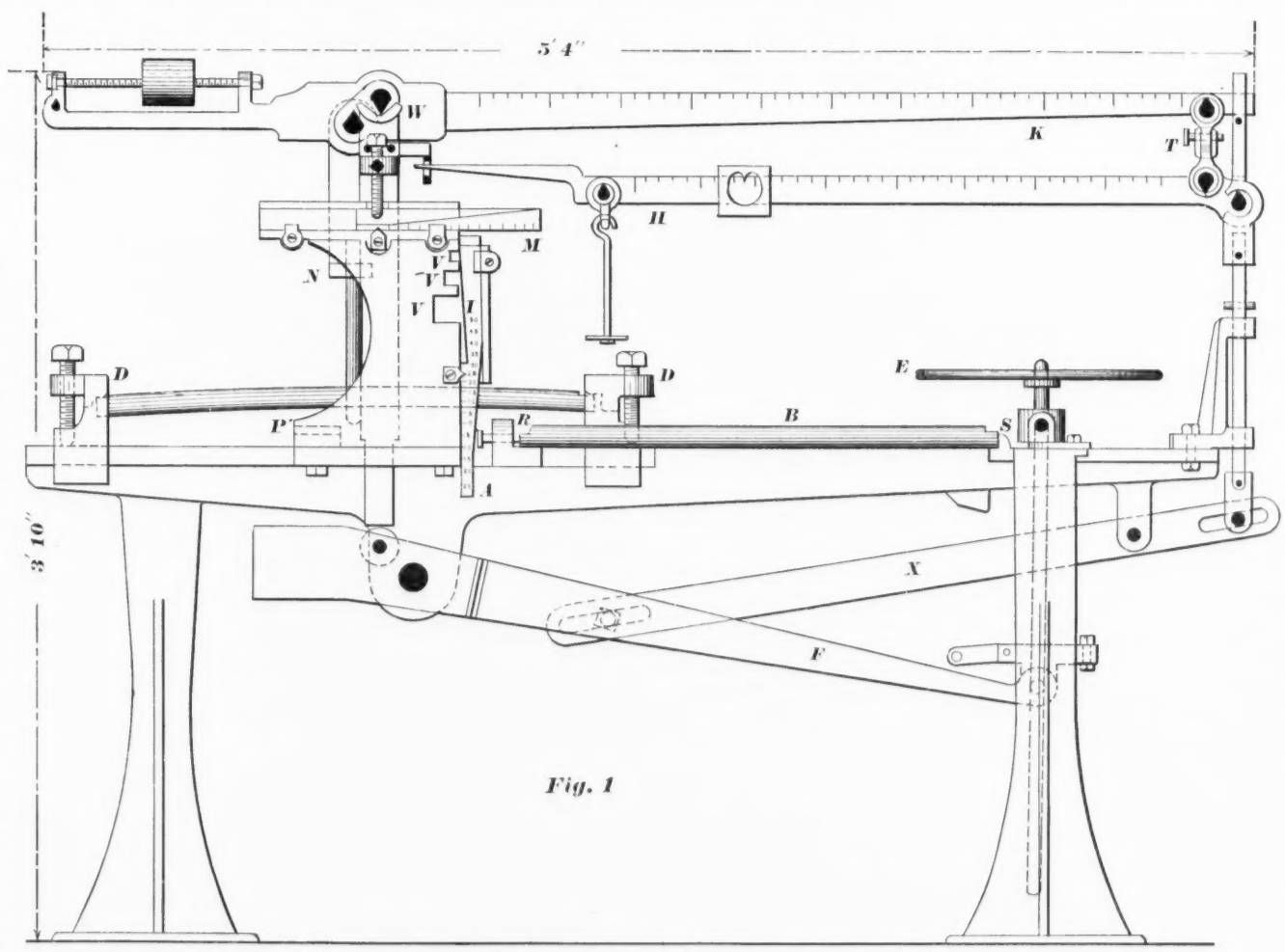


Fig. 1

WEST'S TESTING MACHINE.

Duplex Shingle Planer.

With this we give an illustration of a new machine called a duplex shingle planer. The machine has two tables which pass under the knives alternately, so that while one table feeds the shingle through the machine, the other is returning. The operator needs only to drop the shingles into the hopper, and they are caught by the steel dog on the table and carried through. The tables are 12 inches wide, and shingles up to 12 inches in width and from 18 to 30 inches long can be planed. The makers are E. & B. Holmes, Buffalo, N. Y.

We have, through the courtesy of one of the students, an account of the new building to be erected by the Massachusetts Institute of Technology. The building will be 50x148 feet, five stories and basement. It is to be of brick, with stone trimmings. It is expected the cost will be $70,000. The basement, and the first two floors above, will be used principally by the department of mechanical engineering. Cotton machinery, and various kinds of testing machines, are to be put in. Above this will come the department of civil engineering. It is expected that the building will be completed by early winter.

In the early part of the present year the very first locomotive which had been built in the Colony of Natal passed successfully through its trial at Durban. This locomotive was built in the workshops of the Natal Government. It is a bogey engine, with four coupled wheels, and weighs 35 tons. This is intended as the first of numerous similar productions in view of the extraordinary development anticipated in the iron roadways of southern Africa.—*The Mechanical World.*

Reference is made in the latest British consular report on the agriculture of southern Russia to the increased import of agricultural machinery. English manufacturers enjoy a monopoly of the sale of portable steam engines and steam threshing machines, besides doing a good business in plows. The Americans do far the greatest business in reapers and mowers, those of English make not forming as much as 20 per cent. of the total number imported.

The Tech, published by the students of the Massachusetts Institute of Technology, comes to us for May with the announcement that a new departure has been made in its management. The previous management was cumbersome—so unwieldy in its magnitude that it could not move in reasonable time. We shall look for improvement in our bright contemporary.

Now it is gravely argued that smoke from soft coal, about which a good deal of complaint is made, is extremely healthful, preventing epidemics, or at least moderating their effects. This will no doubt have a comforting effect on those who have foolishly imagined they have suffered from the smoke nuisance.

AMERICAN MACHINIST

To prevent delays all Communications should be addressed to the Company.

PUBLISHED WEEKLY
BY
American Machinist Publishing Co.
96 Fulton Street, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
J. G. A. MEYER, FRED J. MILLER, } Associates.

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Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.
The International News Company,
11 BOUVERIE STREET, Fleet Street, LONDON, ENG., will receive subscriptions for the AMERICAN MACHINIST, at 14/7 per annum, postage paid.

DEALERS SUPPLIED BY

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NEW YORK, JUNE 6, 1889.

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The Value of Special Knowledge.

A few days ago there was published in some of the daily papers a dispatch from Washington, announcing that there would be held at the post-offices in Detroit, Chicago, Boston and New York, an examination for the position of computer in the Nautical Almanac Office. Applicants were to "have a knowledge of the theory and use of logarithms, plane and spherical trigonometry, analytical geometry, differential and integral calculus and plane and spherical astronomy," and for all this the successful candidate is to receive the munificent salary of $1,000 per annum. The knowledge of mathematics specified above really implies, of course, a good deal of knowledge in other branches of learning, the ability to pass such an examination being possessed by very few who have not taken a regular college course. Indeed, it is probable that a large majority of those who have graduated from college would fail to pass such an examination. The computation of the tables printed in the Nautical Almanac, is a work of great importance, and that the U. S. Government should pay to the men who do it, the sum of $1,000 per annum, while more than twice that amount is paid for the services of men who occupy mere clerkships in the departments to which they have been appointed solely as a reward for party services, is a disgrace. It also shows the comparatively small practical value (measured in dollars and cents) of mere general education without the ability to apply it to some specific purpose in connection with other knowledge of a specific character not to be obtained in colleges. A good knowledge of mathematics is a valuable aquisition, of course, but it can seldom be of much use in making a living for its possessor unless he also possesses other knowledge to which his mathematical training is tributary.

Such an instance as this ought also to furnish food for thought by those who seem to think that all that is needed to relieve society of the burdens which oppress it, and the dangers which threaten it, is to make everybody educated, blinding their eyes to the fact that it is only in proportion as men lift themselves above others that they are successful. It is evident that if every common laborer possessed the knowledge to enable him to make computations for the Nautical Almanac, the wages paid for making such calculations would fall to the standard of the common laborers.

A Young Hollander's Plan.

We admire the spirit shown by a young Hollander, the son of a wealthy manufacturer employing hundreds of workmen in the construction of machinery and in the manufacture of cotton goods. The young man, who is intelligent and well educated, developed a taste for wood-working, and, desiring to set up as a manufacturer of sash, doors, blinds, etc., he, with his father's consent, came to this country, and, omitting all mention of or reference to the fact that his situation differed in any way from that of others about him, worked in the factories of this country for three years, depending entirely upon himself, and taking the world as he found it. While he worked he kept his eyes open, made himself thoroughly familiar with every detail of the business; finally, after learning all he wanted to know, abandoning his incognito, and traveling about the country, adding the benefits of an extensive observation to the knowledge gained by experience.

This young man was so situated as to make it easy for him to avoid doing actual work, the wearing of overalls, soiling of hands, and other disagreeable things incident to the earning of a living, which usually have to be borne by young men who do not happen to be the sons of wealthy manufacturers; but he chose to do these things as the best possible preparation for the business he proposes to follow, and we think his choice was a wise and sensible one, doing credit both to him and to his father.

Technical schools are plenty in Europe; this young man might have gone to one of them and "learned the use of tools"; but he knew, and his father knew, that there were many things which it would be of advantage for him to know as a manufacturer, which no school could possibly teach, and which can only be learned in an actual shop, in which men are working for a living, making goods to compete with others in the market for price and quality. We predict that the young man who has shown such good judgment, and so much "grit" in this matter, will be successful as a manufacturer, and, moreover, that he will be a better man to work for than he would have been without this experience. For we think it may be stated as a general rule, to which there are few exceptions, that those employers who have the best practical knowledge of the trades which their workmen follow have the best success in getting along, and avoiding friction with their employes. It is easier for workmen and employers to understand each other; each knows that the other understands just what he is talking about when any question arises in regard to the work, and a great deal of misunderstanding, distrust and friction is avoided, which often cannot be avoided where the employer, ignorant of the practical details of his business, thinks, as he is apt to, that everything going on about the shop, not fully explained to and understood by him, is useless; probably is a scheme to "beat" him; and that the workman or foreman is perverse, stubborn and unreasonable if he refuses to explain, and ignorant or dishonest if he attempts an explanation and fails—as he usually does.

Finally, to return to our young Hollander—he has learned, among other things, the value of American machinery, and before returning home will purchase a full outfit of it for his factory.

We think the plan pursued by him is a commendable one in every respect: first, in deciding to familiarize himself with the practical details of the business he proposed to follow in the only way in which he could do so thoroughly; and, second, in not confining himself to his own country, but choosing that country where the best methods are employed and the best machinery used in the line of manufacture to be followed.

Profit-sharing in Manufacture.

It is evident that many manufacturers in this country are becoming impressed with the policy of profit-sharing as applied to their workmen. It is too early yet to hazard an opinion as to the outcome of such a course, when quite generally put in practice, but it seems to be worth a fair trial.

As we understand profit-sharing, there is nothing but pure business in it. It is in no sense a matter of benevolence, any further than benevolence gets mixed up in the ordinary affairs of life. And it is in this fact that profit-sharing has a chance for success.

When some large manufacturing establishment determines to put in force profit-sharing, it is with the idea that at least equal money will be made by the firm, that the workmen will be more contented, and that the business is likely to go on more smoothly. And this is exactly as it should be. This is not saying that those who put the plan in practice would not like to see those who work for them make more money. Most people would like to see their butcher and grocer make money if they were buying their meat and groceries at fair prices.

When profit-sharing is put in practice the employer expects his workmen will be interested to the extent of increasing the profits of the business. This he has a right to expect. It is a poor man who cannot do better than he is now doing, and there is nothing so likely to induce him to do so as the prospect of getting more money for his work.

On the other hand, the workman expects that there will be profits to divide, and that is what influences him to try to increase them. It is, or should be, a fair bargain on both sides, and should be honestly tried, if tried at all.

Profit-sharing to a limited extent is old. That is, there has been for years, in a good many establishments, one or more men who are considered especially valuable in the business, and who, in addition to a salary, receive a percentage of the profits. It appears to have worked well in such instances. But when it comes to applying it to all the men employed in a large manufacturing establishment there are difficulties in the way, no doubt. What these difficulties are, and their magnitude, can only be determined by trial. If all parties enter into the plan with honest intentions to make it succeed, a good many difficulties may be overcome without serious trouble; if it is not entered upon in this spirit, or if the attempt is made to cover other things than appear on the face, it will stand little chance of success.

In many instances the relations between employer and workmen in this country are not such as they should be for the best interests of both. If profit-sharing, while interfering with the rights of none, helps to smooth the way, employer and workmen should alike look upon it with satisfaction.

The Wonders of Natural Gas.

And now we are informed by a special dispatch from Muncie, Ind., that bars of pig iron, after being subjected to the "peculiar dry and intense heat of the natural gas" found there, are, by the mere fact of being thus heated, converted into hard steel; and that nails made from this steel have been tested by experts and pronounced equal to the best steel nails. We are informed that this discovery "promises to revolutionize the manufacture of steel nails." Well, something is wrong with the day which does not bring forth at least one new scheme which "promises" to revolutionize something; but it seems as though this natural gas steel nail making story promises chiefly, or at least it is hoped that it promises to revolutionize some money into the pockets of certain individuals, most of whom live in the vicinity of New York, and who have organized themselves into a company, and acquired possession of a large share of the land about Muncie, which they hope to sell at stiff prices, by inducing manufacturers to come there and make use of this truly wonderful natural gas. We notice from our exchanges that they are doing a good deal of advertising—some of it probably paid for, and some of it free; this "special" about steel nails being probably of the latter variety.

Literary Notes.

The June number of *Scribner's Magazine* begins the publication of a series of electrical articles by eminent writers on the subject. The first article is introductory in its character, and will be followed by others showing the practical adaptation of electricity. These articles will be illustrated in the highest style of the art, and will undoubtedly be of a very interesting character.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(234) M., Cleveland, O., writes: Please give me a rule for finding mathematically the length of a chord for a circular arc, when the length and radius of the arc is given. *A.*—See answer to Question 188, in our issue of April 25, 1889.

(235) W. S., Pittsburgh, Pa., writes: Kindly let me know how to find the general proportions of a link for a locomotive valve motion. *A.*—See articles on "Modern Locomotive Construction" in our issues of February 12 and 26, 1887.

(236) F. A. P., Torrington, Conn., asks: Which is the best material for making ordinary horseshoe magnets? I claim soft iron is the best, while my friend claims hardened steel is the best; Who is right? *A.*—Your friend is right. Magnets of that kind are made of a special brand of steel, made and used for the purpose. Hard steel does

not become magnetized as readily as softer material, but the magnetism is more permanent.

(237) W. S., Philadelphia, Pa., asks: Please give rules for calculating the horse-power of a boiler; also, rules for solving safety valve problems. *A.*—For rating the horse-power of a boiler, see answer to Question 189, in our issue of April 25, 1889; also answer to Question 276, June 2, 1888. For problems relating to the safety valve see AMERICAN MACHINIST, Dec. 6, 1884, page 2.

(238) J. C., Cleveland, Ohio, asks: Please give rule for finding the area of a segment of a circle. *A.*—Cases may occur in which we can readily find the area of a sector which has the same arc as the segment, and then subtract from it the area of a triangle whose sides are the chord and the radii drawn to the extremities of the chord, and thus obtain the area of the segment. But in general, if we know only the radius of the circle, and the angle formed by the radii, we cannot find the area of the triangle without the aid of trigonometry. The following rule, which will give only approximate results, will answer for many practical purposes; it is comparatively a simple one, and does not require a knowledge of trigonometry. To find the area of a segment of a circle, the chord of the arc and the height being known, add together one-fourth of the square of the chord, and two-fifths of the square of the height, and multiply the square root of the sum by four-thirds of the height. Example: The chord is 15 inches, and the height is 2 inches, find the area of the segment. One-fourth of the square of the chord is $\frac{1}{4} \times 15 \times 15 = 56.25$. Two-fifths of the square of the height is $\frac{2}{5} \times 2 \times 2 = 1.60$; and the sum of $56.25 + 1.60 = 57.85$. The square root of this sum is $\sqrt{57.85} = 7.60$. Multiplying this sum by four-thirds of the height, we have $\frac{4}{3} \times 2 \times 7.60 = 20.26$ square inches, which is the area of the segment. The foregoing rule gives the area of the segment greater than it ought to be, but the error is very small, provided the angle of the corresponding sector be small; when this angle is 60 degrees, the error is less than 1-20,000 part of the area, and when this angle is 90 degrees, the error is less than 1-4,000 part of the area. If the angle of the corresponding sector be so large that the rule is not sufficiently accurate, the segment may be divided into a triangle and two smaller segments; and then the area of the triangle calculated by an exact rule, and the area of the smaller segments calculated by the foregoing rule; the sum of the area of the triangle, and the area of the smaller segments will be the area required.

(239) J. W., Newark, N. J., asks: Are the enclosed computations for finding the heating and grate surface and horse-power of a two-flue horizontal boiler correct? The boiler is 48 inches diameter, 25 feet long; two flues, 16 inches diameter. *A.*—They are not correct. In estimating the heating surface, it is customary to include two-thirds of the outer surface of the shell, the whole outer surface of the flues, and two-thirds of the back head, minus the openings cut out for the flues. The area of the back head found in this way is not exactly correct for a boiler having two-thirds of its circumferential area exposed to heat, but will be near enough for the purpose of estimating the heating surface. We shall assume that the boiler is 48 inches outside diameter, and that the flue is 16 inches inside diameter. The circumference of a boiler 48 inches or 4 feet diameter is equal to $4 \times 3.1416 = 12.5664$ feet. Two-thirds of this circumference is $\frac{2}{3} \times 12.5664 = 8.3776$ feet. Multiplying the latter product by the length of the boiler, we have $8.3776 \times 25 = 209.44$ square feet; assuming that the thickness of the flue is ¼ inch, then its outer diameter will be 16½ inches; and its outer circumference will be $16.5 \times 3.1416 = 51.8364$ inches, or $\frac{51.8364}{12} = 4.319$ square feet. Multiplying the circumference by the length, we have $4.319 \times 25 = 107.97 +$ square feet for each flue; and $107.97 \times 2 = 215.94$ square feet for both flues. Assuming the thickness of the shell to be ⅛ inch, then the diameter of the head will be 47 inches, and its area will be $47 \times 47 \times .7854 = 1734.94 +$ square inches; and two-thirds of this area is equal to $1734.94 \times \frac{2}{3} = 1156.62$ square inches. The openings cut in the head will be 16½ inches diameter, and the area of each will be $16.5 \times 16.5 \times .7854 = 213.82$ square inches, and the area of both openings will be $213.82 \times 2 = 427.64$ square inches. Subtracting the latter area from that of the head, we have $1156.62 - 427.64 = 728.98$ square inches, or $\frac{728.98}{144} = 5.06$ square feet. Now adding together the area of the shell, flues and head, we have $209.44 + 215.94 + 5.06 = 430.44$ square feet for the total heating surface. It may be here stated that, in finding the heating surface, many boiler makers take the inner surface of the flue instead of the outer surface as we have done. The grate area will depend on the kind of fuel which is to be used; sometimes one square foot of grate area is allowed for every 20 square feet of heating surface, and sometimes the ratio is as 1 to 30; and in some cases the grate area is determined by the quantity of fuel to be burnt per square foot; the latter method is the best. Assuming that the ratio of the grate area to the heating surface is to be as one to 30, then we will require $\frac{430.44}{30} = 14.34 +$ square feet of grate. As for horse-power, we divide the total heating surface by the number of square feet of heating surface allowed for each horse-power. Some manufacturers allow 15 square feet of heating surfaces, others 12 square feet, and sometimes even less per horse-power. Adopting 15 square feet of heating surface per horse-power, we have $\frac{430.44}{15} = 28.69$ horse-power. 2. I am running a 20×48 Corliss engine. How can I find the weight of the engine? *A.*—Either calculate the weight of each piece, or write to the makers.

(240) E. M. B., Pittsburgh, Pa., writes: With a vertical cylinder, whose bore is 40 inches diameter, fitted with a piston weighing 17 tons, with a steam pressure of 100 pounds per square inch during the entire stroke, what would be the weight or force of a blow struck when the piston has traveled 9 feet? Please give formula. *A.*—It will be a difficult matter to determine exactly the force of the blow under the given conditions. But we can form a very fair estimate of the force capable of doing work, by finding the stored-up energy in the piston at the moment it has traveled through 9 feet; this we will endeavor to make as plain as possible. Our first step will be to find the mass of the descending body, which is the piston in the case before us. The mass is found by dividing the weight of the body by the acceleration in feet per second, due to gravity; this acceleration is generally denoted by the letter g, and for practical purposes its value may be taken at 32.2 feet per second. The weight of the piston is 17 tons, or $17 \times 2{,}000 = 34{,}000$ pounds. Putting w for the weight in pounds, and m for the mass, we have

$$m = \frac{w}{g} = \frac{34{,}000}{32.2} = 1055.9, \text{ say } 1056.$$

Our next step will be to find the acceleration in feet per second of the piston due to the accelerating force. The accelerating force is made up of the effective steam pressure, and that due to gravity. Allowing a pressure of 10 pounds per square inch of piston to overcome friction, we have an effective steam pressure of $100 - 10 = 90$ pounds per square inch of piston. The area of a piston 40 inches diameter is 1256.6 square inches, hence the total pressure on the piston is $1256.6 \times 90 = 113{,}094$ pounds. The force due to gravity is equal to the weight of the piston; therefore we have a total accelerating force of $113{,}094 + 34{,}000 = 147{,}094$ pounds. Putting f for this accelerating force, a for the acceleration, and m for the mass as before, we have $f = m\ a$, consequently $a = \frac{f}{m}$. Putting in place of f and m their proper values, we have $a = \frac{147{,}094}{1{,}056} = 139.2 +$, say 139 feet per second. We must now find the velocity in feet per second at the time the piston has descended 9 feet. For this we have the formula $v = \sqrt{2\ a\ s}$, where s is the distance through which the piston has descended; in the case before us $s = 9$ feet, and v is the velocity in feet per second. Hence we have $v = \sqrt{2 \times 139 \times 9} = \sqrt{2{,}502} = 50$ feet per second. We are now in a position to determine the stored-up energy in the piston at the time it has descended 9 feet. This is determined by the formula $\frac{m\ v^2}{2}$ the letters denoting the same values as before. Replacing the letters by their values, we have $\frac{1056 \times 50^2}{2} = 132{,}000$ foot pounds, or 66 foot tons, which is the total energy stored up in the piston; that is to say, the piston is capable of performing an amount of work equal to 66 foot tons. The work is the product of $f\ s$, where f is the force or resistance overcome, and s is the distance through which it is overcome. The product $f\ s$ is numerically equal to $\frac{m\ v^2}{2}$ hence we have $f\ s = \frac{m\ v^2}{2}$. This shows us that the amount of work required for bringing the piston to rest must be equal to 66 foot tons. Hence, if, for instance, the piston is brought to rest through a distance of 2 feet, then the average force exerted will be $\frac{66}{2} = 33$ tons; and if the piston is brought to rest through a distance of 1 foot, then the average force exerted will be 66 tons; and lastly, if the piston is brought to rest through distance of ½ foot, then the average force exerted will be $\frac{66}{.5} = 132$ tons.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue

Gear wheels and g-cutting. Grant, see adv., p. 16.

Link-Belting and Sprocket Wheels.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Engineering Co., Philadelphia and N. Y.

$100 Reward, page 14.
$100 Reward, page 14.
$100 Reward, page 14.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

20″ Upright Drills. J. E. Snyder, Worcester, Mass.
23″ Upright Drills. J. E. Snyder, Worcester, Mass.
25″ Upright Drills. J. E. Snyder, Worcester, Mass.
28″ Upright Drills. J. E. Snyder, Worcester, Mass.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

"The Bulldozer," a new departure; forging by pressure. M'f'd by Williams, White & Co., Moline, Ill.

Man'f'rs of Sash Weights, write to Humphrey & Good, Bellefontaine, O., for valuable information.

S. W. Card & Co., Mansfield, Mass., carry a full line of Stay Bolt and Patch Bolt Taps.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Best silk wiping towels for machinery in the market. S. A. Smith, 23 S. Canal st., Chicago, Ill.

Ice and Refrigerating Machines, 131 sold, and all successful. David Bovle, 521 Monroe st., Chicago, Ill.

Iron Planers from 16″ to 36″ wide by any length. H. C. Pease & Co., Worcester, Mass.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See May 9, p. 15. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

The best Emery Wheel made is the "Norwich." For particulars send to Montgomery & Co., 105 Fulton st., New York.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Most sensitive and durable Damper Regulator made; works within one pound; send for circular. T. Kieley, 11 W. 13th st., New York.

The hook on steam engines is being supplanted by the Dill disconnecting device, made by the T. C Dill Machine Company, 726 Girard ave., Phila., Pa.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches, working drawings for the transmission of power by steam, water, air and electricity.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing grey iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N. Y.

Steam Boilers: Their management and working on land and sea. By Jas. Peattie. Practical facts from 30 years' experience. 230 pages illustrated, 12mo., cloth, $2.00. Circulars and Catalogue of Books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N. Y.

Patterson, Jordan & Gottfried, 146-150 Centre st., N. Y. Metals, Machinery, Hardware, Tools and Supplies for Machinists, Mills, Engineers, Brass Goods Mfrs., Factories, etc. An extensive assortment of Bolts, Screws, Wire, Taps, Drills, etc., carried in stock.

Patent or shop rights for sale, for perforating iron or steel plates for steam boilers, bridge work, iron or steel ship work, marine boiler heads, equal to drilled work and fifteen times quicker. Samples can be seen and circulars obtained from R. E. Dietz, 60 Laight St., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G Co., 96 Fulton st., New York.

"Practical Drawing." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including May 23, 1889 issue, 77 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING Co., 96 Fulton st., New York.

"Modern Locomotive Construction." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 92 articles have thus far appeared up to and including the May 30, 1889 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada, at 5 cents each. AMERICAN MACHINIST PUBLISHING Co., 96 Fulton st., New York.

MANUFACTURES

An iron foundry will be built at Americus, Ga., by Hegerman & Bayard.

The Middle Georgia Manufacturing Company will build a cotton-seed oil mill at Griffin, Ga.

Something like a half dozen companies have been organized to furnish natural gas to Brandenburg, Ky.

Redwitz & Genert propose to establish works at Anniston, Ala., for the manufacture of their cotton-seed oil mill.

It is reported that the Illinois Central Railroad will establish a machine shop and roundhouse at Durant, Miss.

John Van Landingham is at the head of a stock company being organized to manufacture shoes at Charlotte, N. C.

A stock company, with which L. A. Green is connected, is being organized, to build a cotton factory at Williston, S. C.

The Sharon Steel Casting Company, of Sharon, Pa., is increasing the capacity of its works for producing open-hearth steel castings.

Henry R. Worthington, New York, has opened a branch office for the sale of pumps and hydraulic machinery at 338 Sibley street, St. Paul, Minn.

Singer, Nimick & Co., of Pittsburgh, Pa., are putting in a Boulton apparatus for making solid steel ingots, manufactured by the Solid Ingot Company, of Newark, N. J.

The New Orleans, Fort Jackson & Grand Isle Railroad Co. have been granted right of way through Algiers, La., on condition that they build their shops there.

The citizens of Marlyn, Ind., have voted to donate $40,000 to the Toledo, St. Louis & Kansas City Railway, as an inducement for the road to locate its shops there.

A. W. Steinbacker and George Komp have incorporated the Steinbacker-Komp Machine Co., at Louisville, Ky., for the manufacture of machinery. The capital stock is $6,000.

The Macklin Adjustable Car Seat Company has been incorporated at Chicago. The company will manufacture car seats and other railroad appliances. The incorporators are A. B. Macklin, G. A. Yuille and D. L. Lowd.

Farrar & Higgins have organized a stock company, capital $50,000, to convert their planing and saw mill at Anniston, Ala., into a furniture and novelty manufacturing company. An addition will be made to the present buildings.

The Standard Manufacturing Company, Moore's Hill, Ind., inform us that they have increased their capacity for manufacture to three times the original, and that, with special tools, they will be able to fill orders more promptly in the future.

The Iron Bay Manufacturing Co. will remove their entire plant from Marquette, Mich., to Duluth, Minn. The firm employs 200 men, and is a large manufacturer of engines, mining machinery, hoisting engines and the like, as well as of general foundry casting and of boilers of all styles.

The Chattanooga (Tenn.) Plow Co. is building an addition to its grinding department, and one to its foundry. The increase in business has demanded increased facilities, until the original 20x50 building has spread over two acres of ground. The works are running day and night on orders.

The Valley Iron Works, of Williamsport, Pa., want to remove their works to a southern point and organize a $200,000 stock company for the manufacture of engines, boilers and wood-working machinery, they to take $150,000 of the stock, and the rest to be subscribed by the citizens of the point where located.

Moses Frank and others have applied for a charter for the Mutual Bag Co., of Atlanta, with a capital stock of $500,000. The business of the company will be the manufacture and sale of paper, cotton, burlap, and pine fiber bags, cotton and pine fiber cloth, twines, and the various branches pertaining to such business.

The Rockford Bit Company is preparing to expend $15,000 this summer in building additions to the already extensive works at Kokomo, Ind. The present capacity is entirely unequal to the market demand for the tools of this brand, and arrangements will be made to increase the output of last year by quite two-thirds.

It is reported that an Eastern syndicate are negotiating with the view to the erection of an iron furnace and steel works at Leeds, Ala., costing $500,000, the blast furnace to have a capacity of 125 tons, and the steel plant a daily output of fifty tons. The condition is the donation of 100 acres of land for a site and operatives' village.

G. H. Toadvine and Randolph Humphreys, of Salisbury, Md., and Thomas W. Smith, of Washington, D. C., have chartered the G. H. Toadvine Lumber Co. They have purchased timber lands in North Carolina, and are building a saw mill at Elizabeth City, N. C., and will build a planing mill. The plant at Salisbury will be moved to Elizabeth City.

One of the growing industries of San Diego county, Cal., is the manufacture of asbestos goods. At Pacific Beach are located works that cost several thousand dollars, where cement and roof and house paints are made. More machinery is being put in to facilitate the manufacture of these, and a kiln will at once be erected for the making of asbestos brick.

The editor of the Whatcom (W. T.) *Reveille* says he has received two letters from eastern men who desire to establish a sash and door factory there, but that it is impossible to secure a site within the city limits without buying the imaginary title of some jumper who has plastered the tide flats over with a forest of piles, in the hope of getting something for nothing from Uncle Sam or the new State.

We have it on authority that the Worcester Steel Works, of Worcester, Mass., will not remove their extensive plant from Worcester to Newport, R. I., as has been rumored. The result of this company's coal mining in Portsmouth, R. I., is exceeding their most sanguine expectations. The coal is perhaps the best ever used for smelting purposes, containing 90 per cent. of carbon, and the company use it extensively, but not exclusively, in the works at Worcester. They say that some time in the future they may erect a furnace at Portsmouth, R. I., but are not fully decided.—*The Commercial Bulletin.*

The directors of the Bourne Mills Corporation Fall River, Mass., have decided to adopt a plan of profit-sharing with the operatives. A circular has been issued to the operatives, offering them a share in the profits of the mill for the six months from July 1, 1889, to Jan. 1, 1890. The exact details have not yet been determined, but it is proposed that every employe continuing in the employ of the company for the above time shall receive some share of the profits, to be paid in cash on or before the 10th day of February, 1890, in proportion to the wages earned for the whole six months. The total amount so divided shall not be less than six per cent. of the amount of cash dividends declared and paid to the stockholders.

Machinists' Supplies and Iron.

NEW YORK, June 1, 1889.

Iron—American Pig.—Though there seems to have been no increased demand for finished iron or steel, yet the market for pig has improved somewhat, and the recent cut in prices has resulted in considerable stocking up. A more confident feeling seems to prevail respecting the future. We quote standard Northern brands, No. 1, $16.50 to $17; No. 2, $15.50 to $16. Southern brands, No. 1, $16 to $16.50; No 2, $15 to $15.25. Grey Forge, $14.50 to $15.25.

Scotch Pig.—We quote Coltness, $21.50 to $21.75; Gartsherrie, $20; Summerlee, $21 to $21.50; Eglinton, $19 to $19.25; Dalmellington, $19.75 to $20; Clyde and Langloan, $20.50.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Competent draftsman wants situation. Address A. B., AMERICAN MACHINIST.

Position wanted by mech. draftsman, good ref.; N. Y. or vicinity preferred. Box 105, AM. MACH.

Wanted—First-class pattern maker; steady work and good pay to the right man. Address Box 104, AMERICAN MACHINIST.

Wanted—By young mech'l engineer with first-class practical experience, position as supt. or assistant. Newcomer, AMERICAN MACHINIST.

Wanted—By practical, experienced, pushing iron foundry foreman, a position as such on any class of work. Pusher, AMERICAN MACHINIST.

A tool maker, experienced mechanic, wants position as supt., experimenter or foreman. A1 reference as to disposition and character. Box 106, AM. MACH.

Wanted—Position as foreman by first-class machinist; at present holding same position; heavy work preferred. Address Reliable, AM. MACHINIST

Wanted—A man to act as our agent in the State of New Jersey. Must be more or less technically familiar with steam apparatus, of good address and qualified to plan boilers. Address W. & S., AMERICAN MACHINIST.

Wanted—Foreman boiler maker; must be a man of experience in locomotive boiler work, competent to handle a shop working 300 men. A good position for the right man. Address, stating experience and reference, Foreman B. M., care of AM. MACHINIST.

Wanted—A thoroughly competent and energetic man, to take charge of about 100 men in the machine shop department of an agricultural implement factory in Western Canada; none but an expd. man need apply. Agricultural, AMERICAN MACHINIST.

Wanted—A superintendent for a factory in Ontario, making binders, mowers and horse rakes, and employing 250 hands; must be able to give out piece-work, order stock, and thoroughly acquainted with the interchangeable system and the management of men. Box 103, AMERICAN MACHINIST.

Wanted—Position by a man with over 20 years' experience in the mach'y and supply business, both on the road traveling and in the office; would like to represent some mfg., and would travel or stay in office or store; large acquaintance; best references. Lawrence, AMERICAN MACHINIST.

Wanted—Able, pushing, practical machinist and draftsman with progressive ideas, good general knowledge of mach. and working metals, who in time could take a head position under the gen'l manager either in the U. S. or Canada works, as required; spring-tempered steel goods are our specialty; age preferred, 30 to 40; state exp. and salary; situation permanent to the right man; send photograph with application. Box 700, Guelph, Canada.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Just out; aluminum-steel hack-saws, hard but not brittle. Crescent Mfg. Co., Cleveland, O.

New catalogue of engineers' specialties free. Crescent Mfg. Co., Cleveland, O.

Steel Name Stamps, Copper Burning Brands, etc. W. G. Sackmann, 1099 First av., Cleveland, Ohio.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

August C. Christensen, 24 State st., N. Y., Consulting Engineer. Designs of all kinds of Machinery.

Turned and Highly Polished Iron and Steel Shafting a specialty. Merwin McKaig, Cumberland, Md.

Engineers wanted to send their addresses and receive free a 25 cent book, "Hints and Suggestions for Steam Users." Lord & Co., P. O. Box 1262, Phila., Pa.

Room and power to rent to suit any capacity, large or small. Inquire of Hartford, Conn., Board of Trade.

Wanted—By a reliable foundry and machine company, a few specialties to manufacture; patented articles preferred. F. & M. Co., AM. MACHINIST.

Wanted—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

Wanted—100 or more machinists or amateurs to send for model engine castings; complete in sets; send for circular. Lowell Model Co., 170 Merrimack Street, Lowell, Mass.

Wanted—At once, two combined punching and shearing machines, new or second-hand, to punch 1¼" hole in 1¼", and shear 1¼" with 30" gap, with or without eng's attached. State price delivered in Toronto. The Polson Iron Works Co. (Ltd.), Toronto.

Established 1832. BRADLEY'S POWER HAMMERS
The BEST in the WORLD
RUN BY BELT.
Over 1500 in USE
BRADLEY'S HELVE HAMMER. BRADLEY'S UPRIGHT HAMMER. BRADLEY'S UPRIGHT HAMMER.
BRADLEY'S HEATING FORGES
Indispensable in all shops to keep BRADLEY'S CUSHIONED HAMMERS and men fully employed and reduce the cost of production.
BRADLEY'S HARD COAL HEATING FORGE. BRADLEY'S SOFT COAL FORGE.
BRADLEY & CO. SYRACUSE, N.Y.
63 Murray st. NEW YORK; 98 Sudbury st. BOSTON, MASS.

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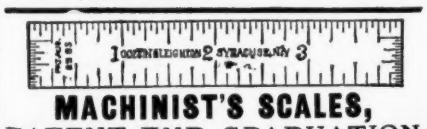
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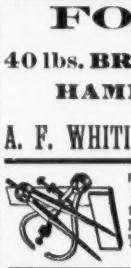
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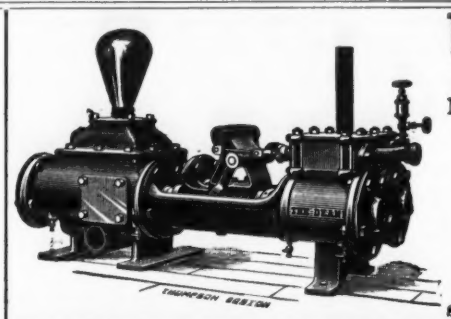
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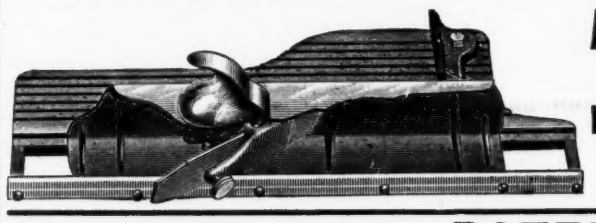
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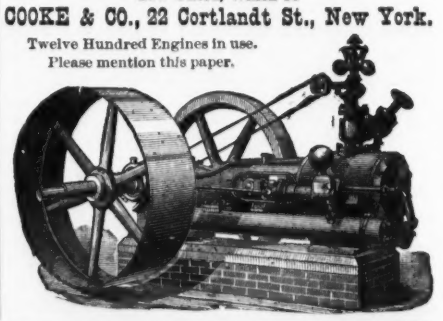

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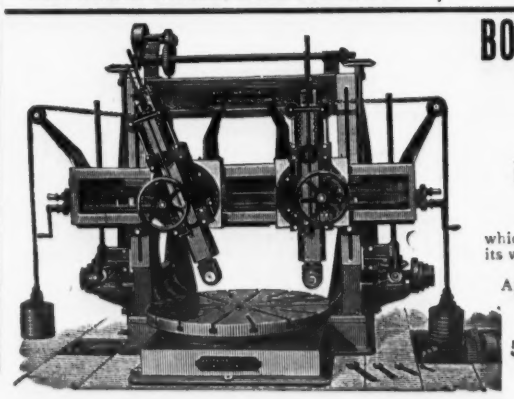
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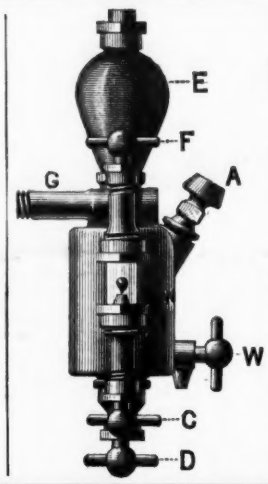

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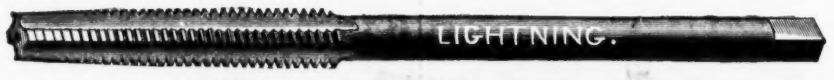

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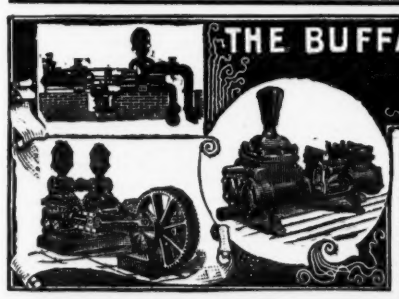

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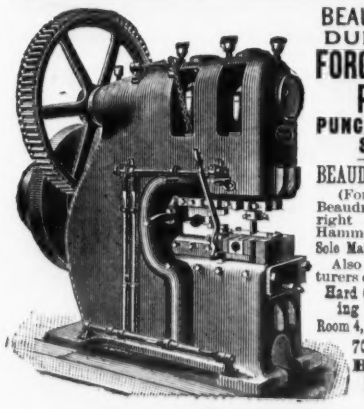

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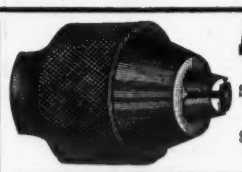

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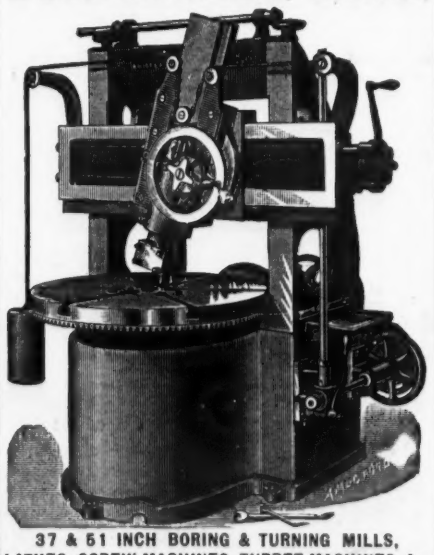

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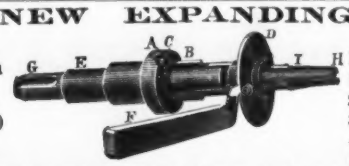

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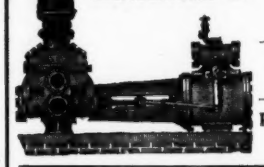

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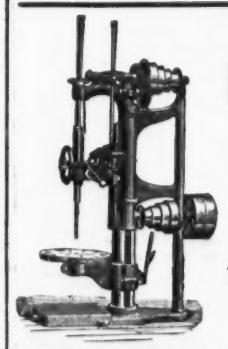

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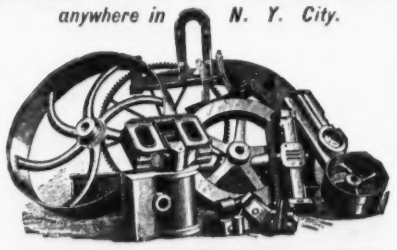

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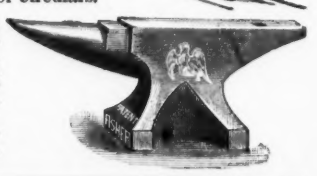

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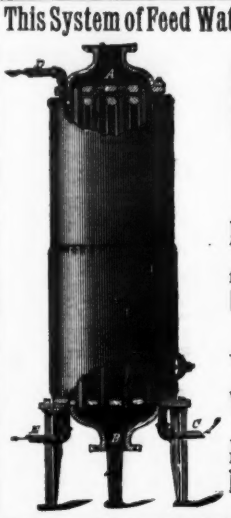

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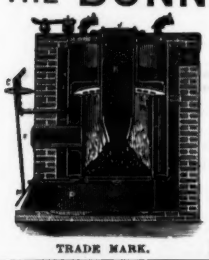

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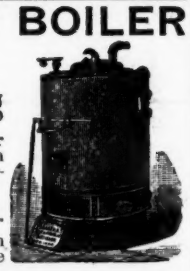

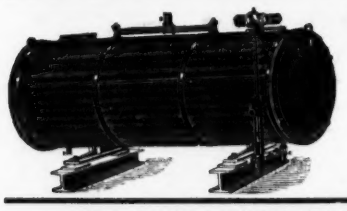

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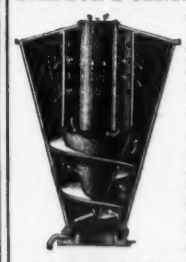

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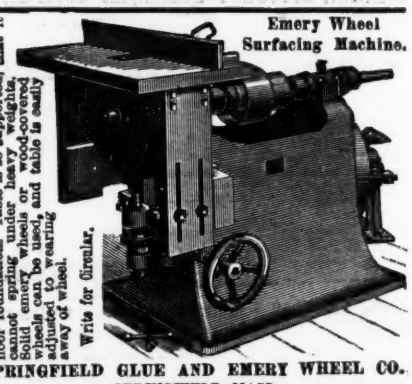

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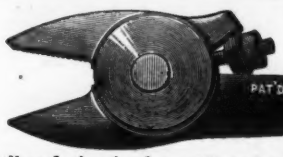

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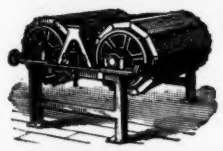

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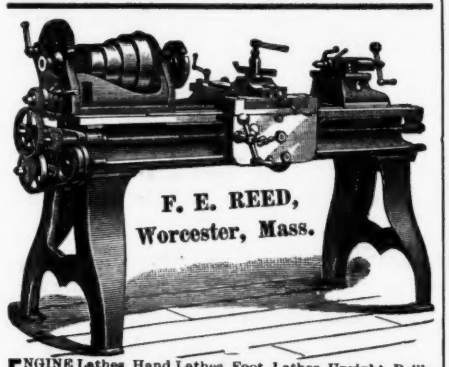

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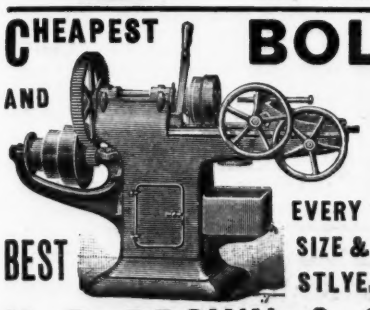

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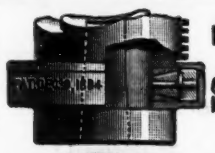

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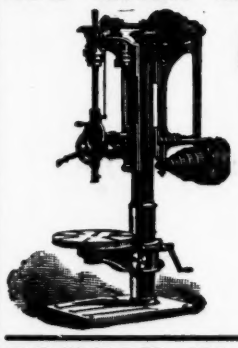

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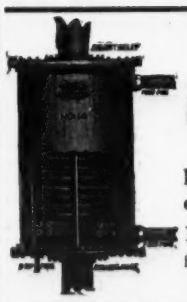

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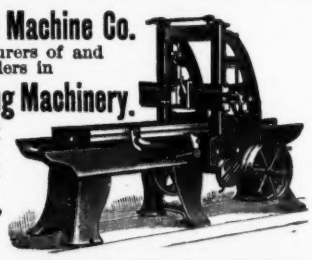

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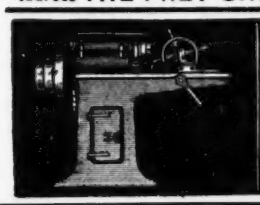

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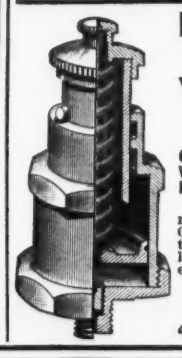

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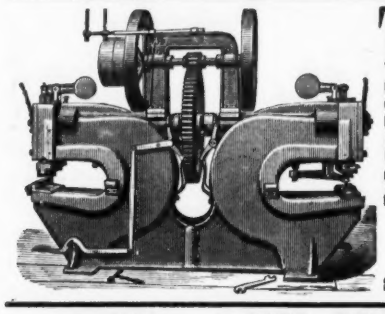

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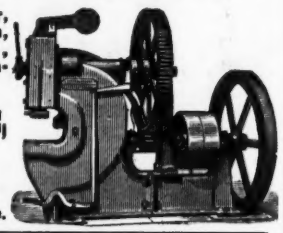

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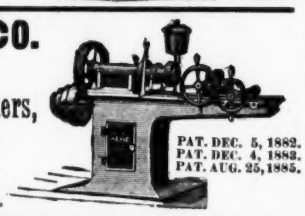

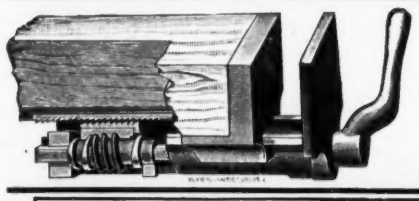

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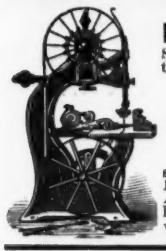

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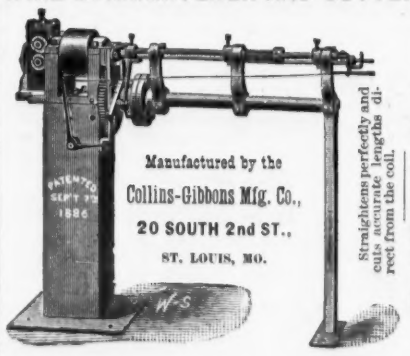

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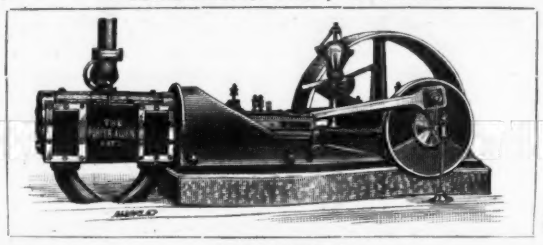

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PORTER-ALLEN AUTOMATIC ENGINE.
HIGH ECONOMY. DURABILITY. CLOSE REGULATION.

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PHILADELPHIA, PA.
—BUILDERS OF—
METAL-WORKING MACHINE TOOLS
FOR
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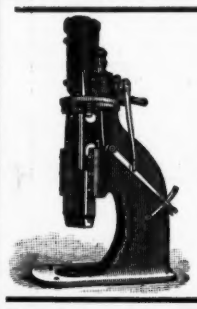
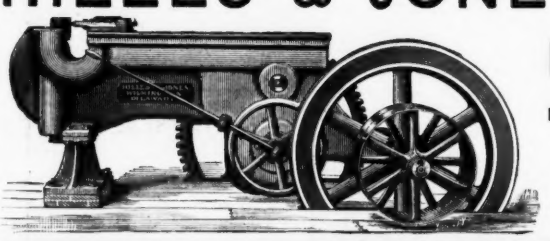
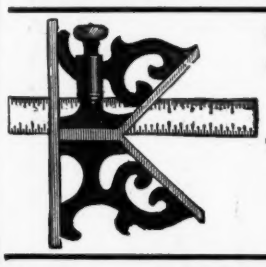


HILLES & JONES, WILMINGTON, DELAWARE,
MANUFACTURERS OF
MACHINE TOOLS,
FOR
BOILER MAKERS, BRIDGE BUILDERS, SHIP BUILDERS, RAILROAD SHOPS, LOCOMOTIVE AND CAR BUILDERS, ETC., ETC.
HORIZONTAL FLANGE PUNCHES, ALL SIZES.





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ATHOL, MASS.,
MANUFACTURERS OF
The Celebrated Chaplin Try and Center Square, Standard Steel Rules, Steel Caliper Rules, Universal Bevels, Caliper Gauges, Improved Surface Gauges, Bevel Protractors, Depth Gauges, Screw Pitch and Center Gauges, Hardened Steel Squares, Graduated Steel Squares, Spring Calipers, Pliers, Straight Edges, &c., &c.
WRITE FOR ILLUSTRATED CATALOGUE AND PRICE LIST OF FULL LINE.

BALL AUTOMATIC CUT-OFF ENGINES,
ERIE, PA.
The characteristics of these Engines are Beauty of Design, Superior Finish, Limited Feet in Space required, Economy of Fuel, Perfection of Regulation.
CHARLES R. VINCENT & CO.,
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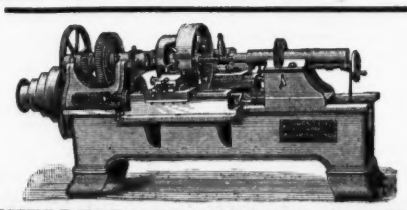

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Pulleys Turned and Bored Simultaneously.
☞ The Greatest Labor Saving Tool of the Age!
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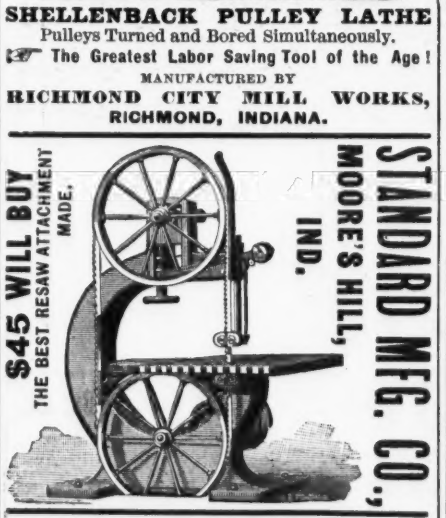

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OF THE
BINGHAMTON HYDRAULIC POWER CO.
BINGHAMTON, N. Y.

THE most efficient and the most economical means of obtaining small power. A Motor which does the greatest amount of work with the use of the smallest stream of water, and which is best adapted for running both cheaply and most efficiently Printing Presses, Elevators, Church Organs, Coffee Mills, Sewing Machines, Lathes and Dental Contrivances, and in fact any piece of Mechanism.
Write for descriptive circular and prices. Mention this paper.

Adjustable Clamping Blocks.
A simple device used to fill under clamps, when clamping work to various machines. Does away with lumber yards, scrap piles and confusion about your shops. Send for descriptive circulars and prices.
ENERGY M'F'G CO.,
1115 & 1123 S. 15th STREET, - PHILA., PA.

PHOSPHOR-BRONZE IN INGOTS & CASTINGS
RED & YELLOW BRASS
BABBITT METALS
PAUL S REEVES 760 S. BROAD ST. PHILA. PA.

THE OPEN SIDE IRON PLANERS.
Their value and efficiency are universally acknowledged and endorsed.
DETRICK & HARVEY,
Manufacturers,
BALTIMORE, MD.

KEUFFEL & ESSER CO., 127 FULTON ST., NEW YORK.
FACTORY: HOBOKEN, N. J.
Manufacturers of **DRAWING MATERIALS, &c.**

"SUPERIOR SWISS" DRAWING INSTRUMENTS.
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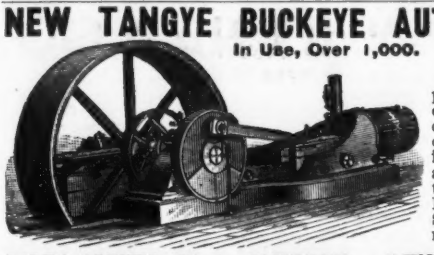
PARAGON, DUPLEX, UNIVERSAL, ANVIL
Drawing, **HELIOS,** Blue Process Papers, Scales, Triangles, T-squares, Drawing Boards, &c.
FULL CATALOGUE ON APPLICATION.

NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES.

In Use, Over 1,000. 25 to 1,000 H. P.



These engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H. P. for driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine Construction and performance, free by mail. **Address, BUCKEYE ENGINE CO., Salem, Ohio.**

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Sole Licensees and Manufacturers for New Jersey (South of Trenton), Eastern Pennsylvania, Delaware, Maryland and Virginia.

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BUCKET AND GRAVITATING

TRAPS.

Bucket.

Automatically drain the water of condensation from **HEATING COILS** and return it to the boilers whether the coils are **above** or **below** the water level in boiler, doing away with pumps and other mechanical devices for such purposes.

We also manufacture **Blessing's Patent Renewable Seat Stop and Check Valves.**—Send for Circular.

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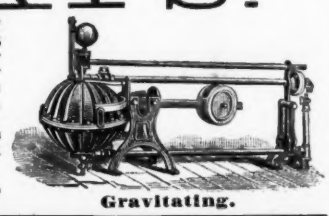
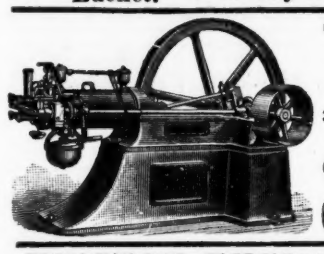


Gravitating.



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OVER 25,000 ENGINES IN USE.

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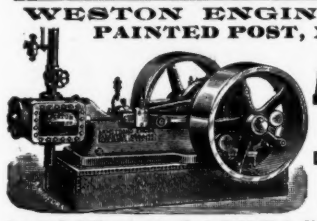

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CORRECT IN Design, Workmanship and Price.
5 to 75 H. P.

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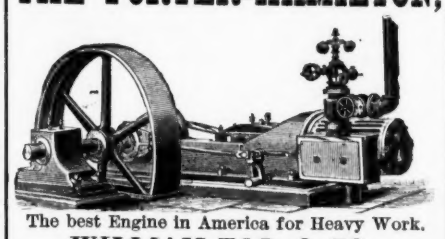

The best Engine in America for Heavy Work.

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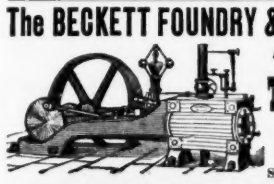
Manufacturers of



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NO BOILER. NO COAL. NO ENGINEER.
No Extra WATER RENT or INSURANCE.
INSTANTLY STARTED.
DURABLE, RELIABLE, SAFE and ECONOMICAL.
Send for description and prices.
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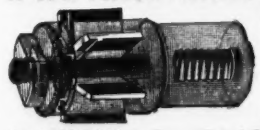
A NEW PATENT ADJUSTABLE REAMER,



thoroughly tested and practical. A set of five will ream any possible size, from 1 3-16 to 4¼ inch.

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In view of the increased demand for our

IMPROVED MACHINE TOOLS

in New England, we have opened at

23 & 25 Purchase Street, Boston,

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IMPROVED ENGINE LATHES, BRASS WORKING TURRET LATHES, SHAPERS, DRILL PRESSES, ETC.

☞ Complete Engine Lathes, Automatic Stop.
☞ Complete Drill Presses, Automatic Stop.
☞ No charge for extra features.
☞ Complete Machine Shop outfits a specialty.
☞ All tools f. o. b. Boston.

LODGE, DAVIS & CO.
23 & 25 PURCHASE ST., BOSTON.
WORKS: CINCINNATI, OHIO.

☞ See advertisements, pages 14 and 16.

MACHINERY ON HAND.

16 in. x 42 in.	Planer,	Bridgeport,	new
22 in. x 5 ft.	"	Hendey,	new.
22 in. x 5 ft.	"	Powell,	"
24 in. x 6 ft.	"	Powell,	"
30 in. x 8 ft.	"	each Atherton, Powell & H. & P.	new
36 in. x 6 ft.	Lowell Screw Planer,		cheap.
36 in. x 14 ft.	Betts,		good.
36 in. x 10 ft.	New Haven,		"
6-8-10-12-15 in.	Crank Shapers.		
15 x 20 in.	Friction Shapers.		
20-24-26 and 32 in.	Geared Shapers.		
12 in. x 6 ft.	Engine Lathe,	Young,	new.
14 in. x 6 ft.	"	Blaisdell,	"
14 in. x 7 ft.	"	Bogert,	"
15 in. x 6 and 8 ft.	"	Porter,	"
16 in. x 6 and 8 ft.	"	Blaisdell,	"
16-20 in. x 6-8-10 & 12 ft.		Bridgeport,	"
18 in. x 8-10-12 ft.	"	Different Makes,	"
20 in. x 8-10-14 ft.	"	Different Makes,	"
20 in. any length Bed	"	Bridgeport,	"
20 in. x 12 ft.	"	Wheeler,	fair.
22 in. x 12 ft.	"	Niles,	heavy, good.
24 in. x 8-10-12	"	Bridgeport,	new.
24 in. x 16 ft.		New Haven,	cheap.
26 in. x 12 ft.			"
28 in. x 14-16 & 18 ft.	Engine Lathes, F. & S		new.
26-36 & 50 inch	Pulley Machine, Stevens,		good.
Bement Car Axle Lathe,			"
20 in.	Drill	Davis,	ew.
20-23-25-28 inch	Drills	Blaisdell,	"
20-25-28-32 inch	"	C. & S.	"
24 in.	Plain Drill,	Pond,	fair.
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5 ft.	Arm Universal Radial Drill,		new.
Cabinet Turret Lathe,	Lodge, Davis & Co.		"
No. 2 4 Screw Machine,	Brown & Sharpe.		"
Ames Index Milling Machine,			fair.
No. 2 Garvin Hand Miller,			A 1.
Wood & Light, Heavy Miller,			A 1.
Lincoln Pattern,			good order.
No. 1 and 3 Universal Miller,	Brown & Sharpe,		new.
No. 2 Plain	"	"	fair order.
No. 3 Surface Grinder,	"	"	A 1.
48 in. Gear Cutter, each	Gould & H. & P.		

Cold Rolled Shafting in Stock. Send for List. Write for what is wanted.

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62 College Place and 72 Warren Street, New York.

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MANUFACTURERS OF IMPROVED CORLISS STEAM ENGINES IN FULL VARIETY.
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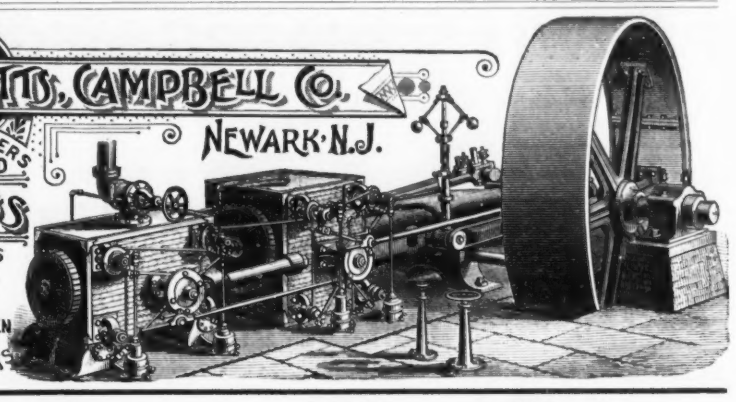

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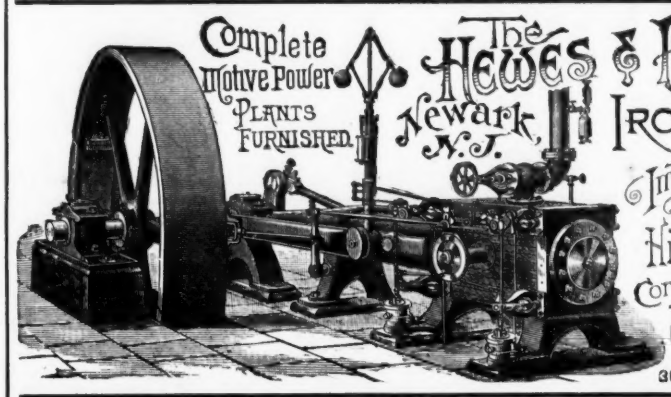
Complete Motive Power Plants Furnished.



Improved CORLISS ENGINES, High Pressure, Condensing and Compound
TUBULAR BOILERS.
HEAVY FLY WHEELS A SPECIALTY.
IN SIZES UP TO 36 FT. DIA. BY 10 FT. FACE.

Eclipse Corliss Engine.

FRICK COMPANY, Builders,
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NON-CONDENSING, CONDENSING COMPOUND.
40 TO 1,000 H.P.
Send for Circulars.

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36 CORTLANDT ST., *NEW YORK,*
Sole Eastern Agents.

JOHN J. METZGER,
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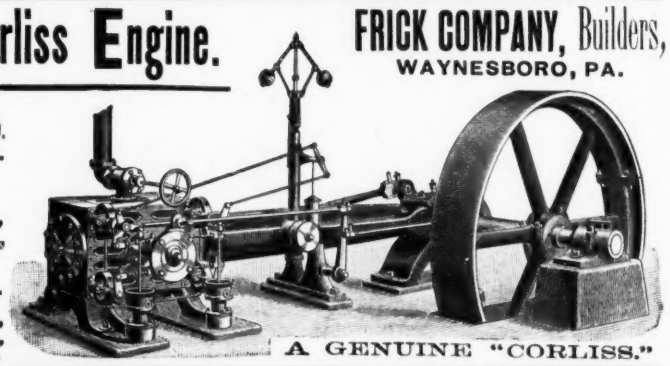
WESTERN AGENT.



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MANUFACTURER OF IMPROVED
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ALSO
SLIDE VALVE ENGINES
STATIONARY BOILERS,
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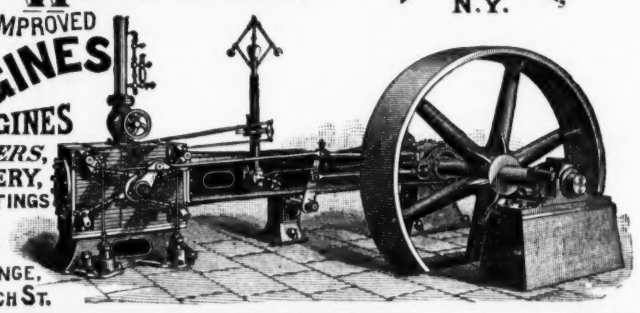
Room 6,
COAL AND IRON EXCHANGE,
Cor. CORTLANDT & CHURCH ST.



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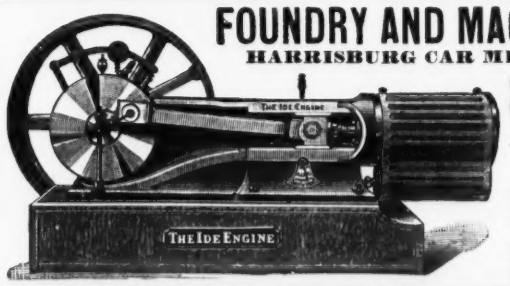
HARRISBURG CAR MFG. CO., HARRISBURG, PA.



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AT FRANKLIN INSTITUTE NOVELTY EXHIBITION, PHILADELPHIA.

We are operating the finest and most successful Electric Light Stations in the world. A change of speed not exceeding one per cent. guaranteed, running light and loaded. Send for catalogue.

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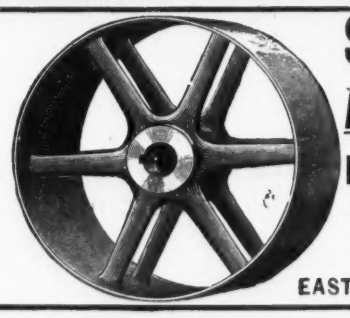

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FIRST-CLASS IN EVERY RESPECT.
Send Specifications for Estimates before Contracting.

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We have placed on the market a Hollow Chisel Mortising Machine which is just as good as our Planer Vise.

Carriage and Woodwork Factories, please write us for prices.

THE GILKERSON MACH. CO., Homer, N. Y.

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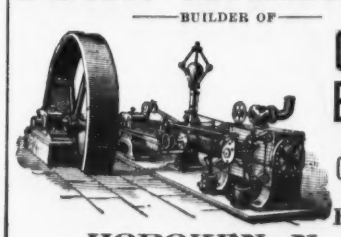
—BUILDER OF—



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STEARNS M'F'G CO.

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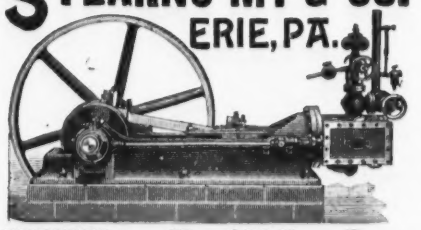

ENGINES from 15 to 400 Horse Power
Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogue.
SAW MILLS and GENERAL MACHINERY
NEW YORK STORE, 46 Cortlandt St.

BROWN & SHARPE MFG. CO.,

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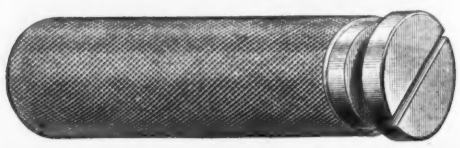

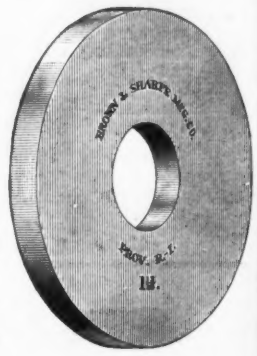

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For use in Setting Calipers, Testing Measuring Tools, and Reference for Sizes in Shop Practice.

They are made of steel, hardened and accurately ground to size.
Price of complete set (45 disks and 6 handles), $35.
Single disks from 60 cts. to $1.50. Single handles from 45 to 60 cts.

Price List Mailed on Application.

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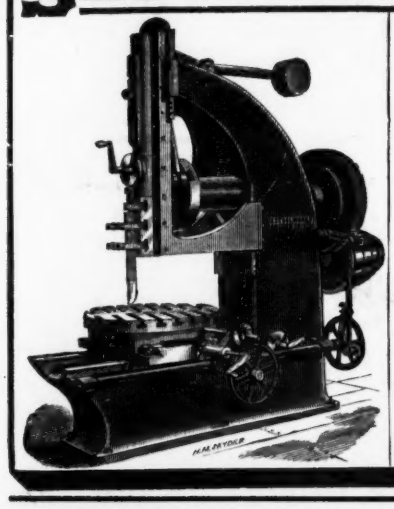

10 to 54 in. Stroke. New Patterns.

RAM GUIDE

ADJUSTABLE VERTICALLY.

Feed always takes place at upper end of stroke—never during cut.

VERY HEAVY AND POWERFUL.

NILES TOOL WORKS,

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JENKINS BROS. PUMP VALVES.

MANUFACTURED BY JENKINS BROS.

We make a specialty of Hard Rubber Pump Valves for Hot Water, Oils and Acids, also for very high pressures.

Accept no Pump Valves as JENKINS or JENKINS BROS., unless stamped like cut.

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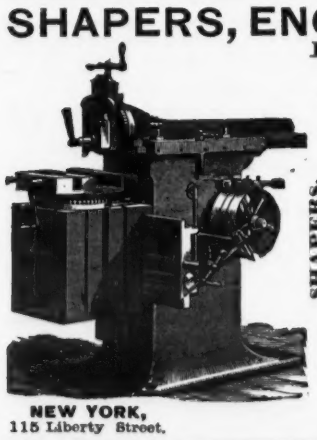
105 Milk St., Boston.
21 No. Fifth St., Phila.

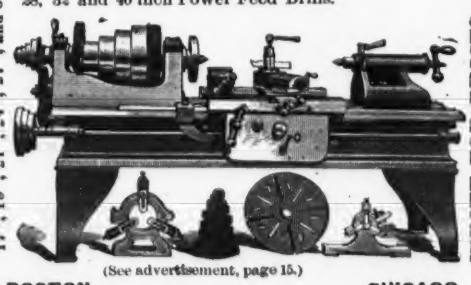
SHAPERS, ENGINE LATHES & DRILLS.

LODGE, DAVIS & CO.,
CINCINNATI, OHIO.



20 inch Upright Drills. 25 inch Back Geared, and
24 " " " "
28, 32 and 40 inch Power Feed Drills.

SHAPERS, 15" and 20" Crank, 20", 26", 32" Geared.
ENGINE LATHES, 17", 19", 21", 24", 27", and 36".



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NEW YORK, 115 Liberty Street.
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E. GOULD & EBERHARDT,

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Eberhardt's New Drill

Turns out 20 per cent. more work than any other. APPLY TO

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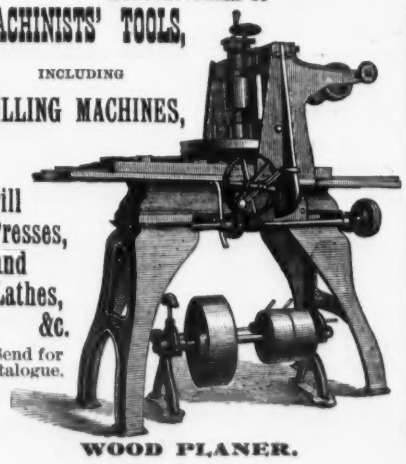

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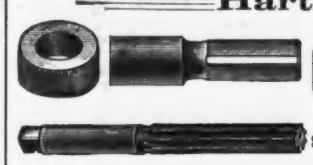

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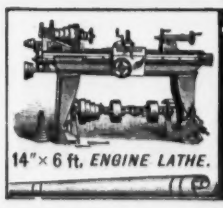

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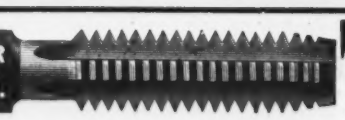

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